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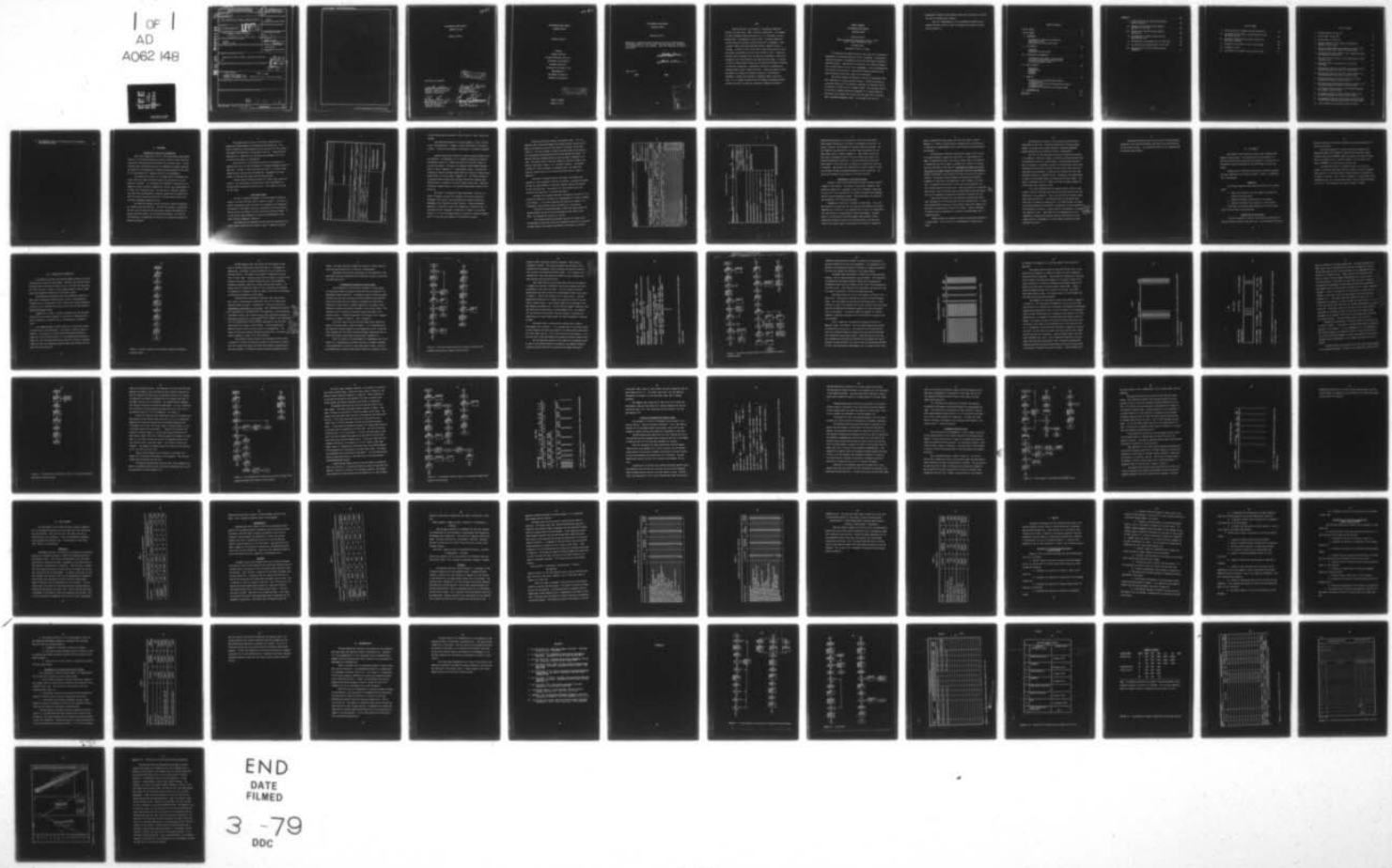

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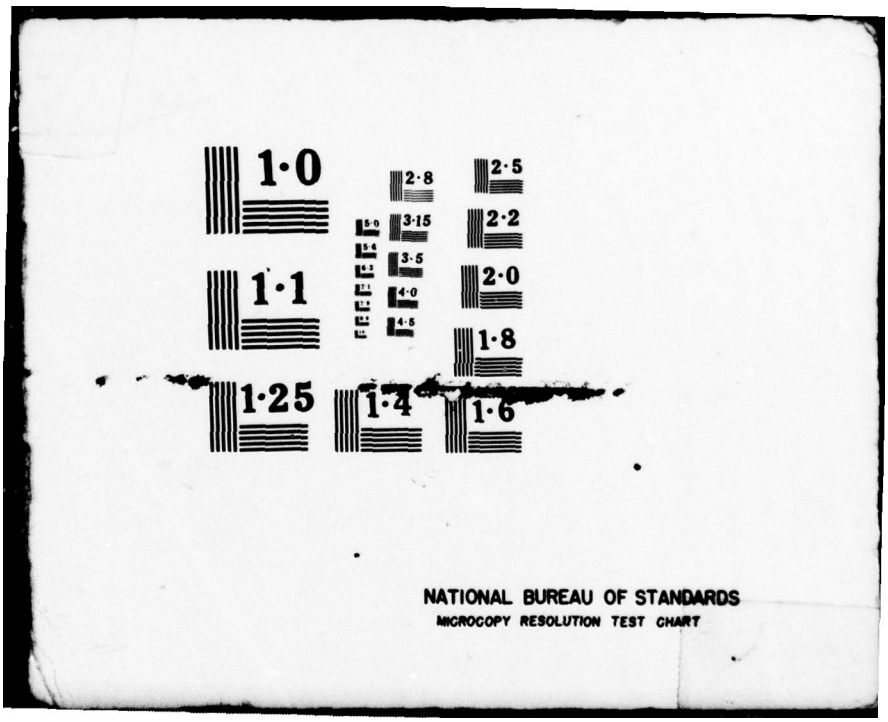
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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFIT-CI 79-27	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): An Automated Work Request Tracking System	5. TYPE OF REPORT & PERIOD COVERED: Thesis
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Nicholas Salerno	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: AFIT Student at Auburn University	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: AFIT/CI, WPAFB OH 45433	12. REPORT DATE: March 17, 1977
	13. NUMBER OF PAGES: 71
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release, Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

JOSEPH P. HIPPS, Major, USAF
Director of Information, AFIT

APPROVED FOR PUBLIC RELEASE AFR 190-17.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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79-27

AN AUTOMATED WORK REQUEST TRACKING SYSTEM

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79-27

AN AUTOMATED WORK REQUEST TRACKING SYSTEM

Nicholas Salerno

A Design
Project Submitted
to the Professional Faculty of
the School of Engineering
of Auburn University
in Partial Fulfillment of the
Requirements of
the Degree of Master of
Industrial Engineering

Auburn, Alabama
March 17, 1977

AN AUTOMATED WORK REQUEST

TRACKING SYSTEM

Nicholas Salerno

Nicholas Salerno
Signature of Author

March 4, 1977
Date

Copy sent to:

Name	Date

VITA

Nicholas Salerno, son of Gasper A. and Margaret (Manocchi) Salerno, was born June 7, 1949, in Bristol, Pennsylvania. He attended St. Ann's Elementary School and Bristol Jr. Sr. High School, Bristol, Pennsylvania. He graduated in June of 1967. He entered Temple University Technical Institute on State Scholarship in September of 1967. In June of 1968, he married Lynda Dee Carleton, daughter of Dora R. Carleton. In March of 1970, he enlisted in the United States Air Force and studied Ground Radio at an Air Force technical school. During his off-duty time he attended local colleges and in December of 1973 he was accepted in the Airman Education and Commissioning Program. In January of 1974, he entered Auburn University and received the degree of Bachelor of Industrial Engineering. Immediately following his graduation he entered Graduate School, Auburn University. During the summer of 1976, he worked as an Industrial Engineer at Gunter Air Force Station, Montgomery, Alabama and continued his graduate studies during this time. He is a member of Alpha Pi Mu, the Industrial Engineering Honor Society, and AIIE, the American Institute of Industrial Engineers.

PROJECT ABSTRACT

AN AUTOMATED WORK REQUEST

TRACKING SYSTEM

Nicholas Salerno

Master of Industrial Engineering, March 17, 1977
(B.I.E., Auburn University, 1976)

82 Typed Pages

Directed by Victor A. Zaloom

An improved work request system for Base Level Civil Engineering Departments in the United States Air Force is presented. A man-machine interface procedure is recommended to track the Work Request through its processing phases. Consolidation of portions of the current procedures into a central decision unit is also recommended. A third recommendation sets forth the provisions for a man-machine interface procedure to be used by planners during their stage of the processing.

The primary concept of operation is the use of Cathode-Ray-Tube, CRT, technology as a source data entry device. The CRT also serves as a retrieval device for file additions, deletions, and inquiries and for the retrieval of data on-line in summary format. The retrievals can be in the form of summary reports for management or in record format to build upon a work request until entry into the shop files of the Engineer's Automated Management System. The concept allows for the

over

programmatic movement of data between stages and the capture of the data only once to maintain data integrity.

Upon full implementation of the recommended alternative, the potential savings to the Air Force are expected to exceed six million dollars annually.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. BACKGROUND

Introduction to Base Civil Engineering

Base Civil Engineering is an Air Force organization whose primary mission is to provide maintenance and repair services to base facilities and military family housing with minimal cost to the Air Force. It also provides minor construction services as a pavement and grounds operation. All details of the organization's operations and procedures can be found in Air Force Manual 85-1, Resources and Work Force Management.

The organization consists of five major areas of management and control which are under the direct control and responsibility of the Base Civil Engineer. It is the Base Civil Engineer's responsibility to manage the overall planning, organization, control, and accomplishment of all Base Civil Engineering work. The divisions of Industrial Engineering, Operations and Maintenance, Programs, Engineering and Construction, and Fire Protection advise the Base Civil Engineer based on their own individual management responsibilities.

The Industrial Engineer directs the quality control evaluations of in-service and self-help work. The Chief of Programs is responsible for the In-service Work Plan and the overall guidance and direction for supply, materials control, cost accounting and funding. The Chief of Fire Protection is responsible for the base fire protection systems and prevention programs.

The accomplishment of work is the direct responsibility of Operations and Maintenance, and Engineering and Construction. The Chief of Operations and Maintenance directs the function of work control and manages the operations of maintenance facilities. Engineering and Construction is responsible for the design and management of all construction within base civil engineering.

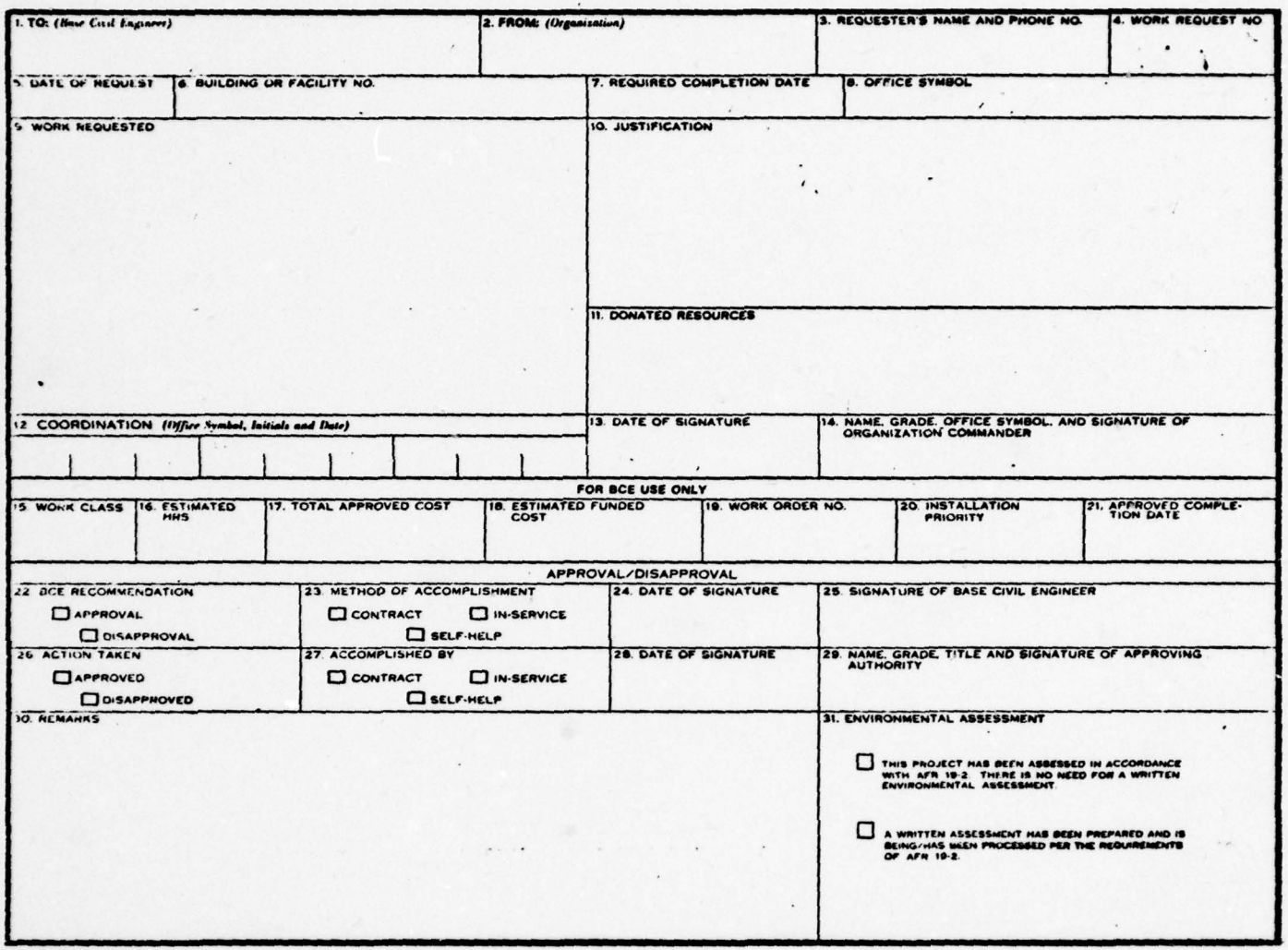
Data pertinent to the operation of Base Civil Engineering is gathered and input into the Base Engineer's Automated Management System's data base. The data is then correlated and output in a variety of management reports both detailed and summarized. Management uses these reports to make decisions about planning and operations.

The Work Request Processing System is a manual input system currently in use which handles the processing of work requirements for military family housing and base facilities. This system is the topic of this study.

The Current System

The basic information document of the Work Request Processing System is Air Force Form 332, which is shown in figure 1. This form is used by organizations other than base civil engineering for requesting the approval of maintenance and minor construction for military family housing costing over $100 or for base facilities costing over $500. It is also used to obtain approval for contract accomplishment of work within the base commander's authority.

The requestor must completely describe the work required on the form in item 9 and provide any sketches, plans or diagrams available.



1. TO: (Base Civil Engineer)
2. FROM: (Organization)
3. REQUESTER'S NAME AND PHONE NO.
4. WORK REQUEST NO.
5. DATE OF REQUEST
6. BUILDING OR FACILITY NO.
7. REQUIRED COMPLETION DATE
8. OFFICE SYMBOL
9. WORK REQUESTED
10. JUSTIFICATION
11. DONATED RESOURCES
12. COORDINATION (Office Symbol, Initials and Date)
13. DATE OF SIGNATURE
14. NAME, GRADE, OFFICE SYMBOL, AND SIGNATURE OF ORGANIZATION COMMANDER
FOR BCE USE ONLY
15. WORK CLASS
16. ESTIMATED MHS
17. TOTAL APPROVED COST
18. ESTIMATED FUNDED COST
19. WORK ORDER NO.
20. INSTALLATION PRIORITY
21. APPROVED COMPLETION DATE
APPROVAL/DISAPPROVAL
22. BCE RECOMMENDATION
☐ APPROVAL
☐ DISAPPROVAL
23. METHOD OF ACCOMPLISHMENT
☐ CONTRACT ☐ IN-SERVICE
☐ SELF-HELP
24. DATE OF SIGNATURE
25. SIGNATURE OF BASE CIVIL ENGINEER
26. ACTION TAKEN
☐ APPROVED
☐ DISAPPROVED
27. ACCOMPLISHED BY
☐ CONTRACT ☐ IN-SERVICE
☐ SELF-HELP
28. DATE OF SIGNATURE
29. NAME, GRADE, TITLE AND SIGNATURE OF APPROVING AUTHORITY
30. REMARKS
31. ENVIRONMENTAL ASSESSMENT
☐ THIS PROJECT HAS BEEN ASSESSED IN ACCORDANCE WITH AFR 19-2. THERE IS NO NEED FOR A WRITTEN ENVIRONMENTAL ASSESSMENT.
☐ A WRITTEN ASSESSMENT HAS BEEN PREPARED AND IS BEING/HAS BEEN PROCESSED PER THE REQUIREMENTS OF AFR 19-2.
AF FORM JUL 73 332 PREVIOUS EDITION WILL BE USED.
WORK REQUEST

Figure 1: The Work Request, AF Form 332.

A justification must be provided in item 10 which is clear, concise and factual.

The processing procedure of the Work Request is given in detail in Air Force Manual 85-1. However, a brief description of the process follows. A detailed Flow Diagram of the process is provided in Appendix I.

The Work Authorization Specialist receives the Work Request from the requestor. He determines if it is properly completed and properly coordinated, assigns it a number (see item 4, AF Form 332, Figure 1), and logs the number in the Base Civil Engineer's Work Request Register, which is shown in Appendix II. A Work Request Folder is prepared and forwarded to several reviewing bodies which are listed on a Routing Slip/ Stamp similar to the one shown in Appendix III. The folder proceeds on an exception basis through each reviewing stage unless suspense dates cannot be met or rejection of the work request should occur. Rejection of the work request returns it to the Work Authorization Specialist for direction.

The folder is reviewed by Program Development, Planning, the Chief of Programs, the Base Civil Engineer, the In-work processing Programmer, Real Estate, and occasionally upon request Engineering Management, Fire Protection and Real Property. Program Development determines if the work is base civil engineering's responsibility, if the justification is adequate, if the work is already in an existing contract, if it will be accomplished by in-service or contract programs, and if it will have some effect on fire protection systems.

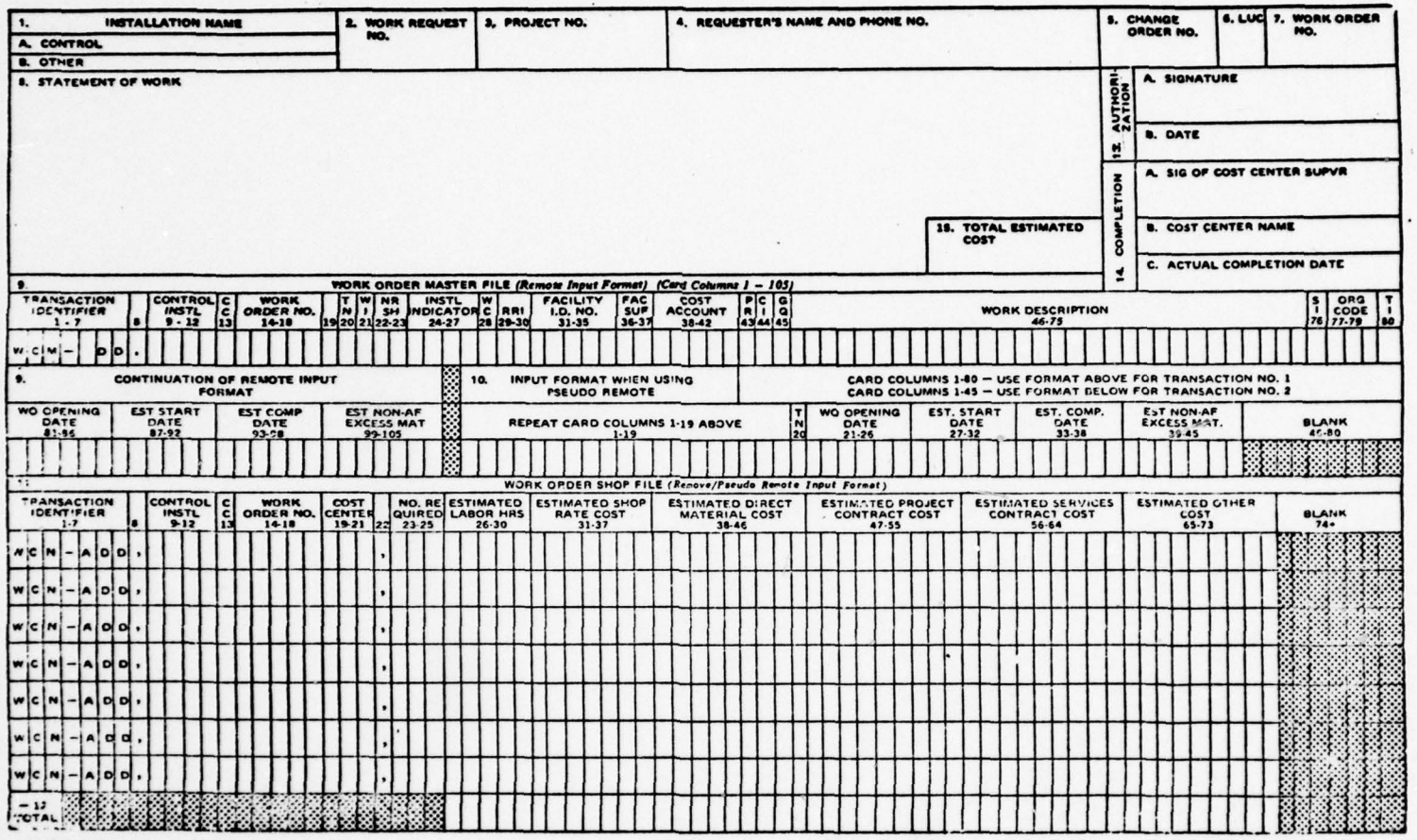
Planning receives the request two different times. First, immediately after Program Development the planner provides the gross estimates of the man-hours and cost (see items 15-18 and 20, AF Form 332, Figure 1). The cost estimate is used by the Work Authorization Specialist to determine which approving official must approve the request. An Approval Authority Schedule similar to the one shown in Appendix IV is used. The second review of the work request by planning is when it has become a Work Order, figure 2, or a Job Order, figure 3. The planner verifies all initial estimates or recomputes them. He commits all materials through the use of Air Force Form 1445, which is shown in Appendix V.

The Chief of Programs receives the folder from planning and decides if a more economical solution is available. He weighs the impact of the work accomplishment on available resources against the backlog of the in-service work. The compliance of the requested work with existing fire regulations is verified once again.

The Base Civil Engineer approves or disapproves the work if it is within his authority or indicates his recommendations in items 22 through 25 of figure 1. If a higher authority must approve the request it is forwarded to that authority before continuing on in the process.

The Chief of Program Development reviews the request again and decides whether the work will be accomplished by Work Order or Job Order. He indicates his decision in item 30.

The In-work-processing Programmer receives the request next. He determines the date the work may be completed and notes it in item 30. He then forwards the requests designated as Work Orders to the Work



1. INSTALLATION NAME
A. CONTROL
B. OTHER
2. WORK REQUEST NO.
3. PROJECT NO.
4. REQUESTER'S NAME AND PHONE NO.
5. CHANGE ORDER NO.
6. LUC
7. WORK ORDER NO.
8. STATEMENT OF WORK
12. AUTHORIZATION
A. SIGNATURE
B. DATE
14. COMPLETION
A. SIG OF COST CENTER SUPVR
B. COST CENTER NAME
C. ACTUAL COMPLETION DATE
18. TOTAL ESTIMATED COST
9. WORK ORDER MASTER FILE (Remote Input Format) (Card Columns 1 – 105)
TRANSACTION IDENTIFIER 1-7 | 8 | CONTROL INSTL 9-12 | CC 13 | WORK ORDER NO. 14-18 | TN 19-20 | WI 21 | NR SH 22-23 | INSTL INDICATOR 24-27 | WC 28 | RRI 29-30 | FACILITY I.D. NO. 31-35 | FAC SUF 36-37 | COST ACCOUNT 38-42 | PR 43 | CI 44 | GQ 45 | WORK DESCRIPTION 46-75 | SI 76 | ORG CODE 77-79 | TI 80
W C M – D D ,
9. CONTINUATION OF REMOTE INPUT FORMAT
10. INPUT FORMAT WHEN USING PSEUDO REMOTE
CARD COLUMNS 1-80 – USE FORMAT ABOVE FOR TRANSACTION NO. 1
CARD COLUMNS 1-45 – USE FORMAT BELOW FOR TRANSACTION NO. 2
WO OPENING DATE 81-86 | EST START DATE 87-92 | EST COMP DATE 93-98 | EST NON-AF EXCESS MAT 99-105
REPEAT CARD COLUMNS 1-19 ABOVE 1-19 | TN 20 | WO OPENING DATE 21-26 | EST. START DATE 27-32 | EST. COMP. DATE 33-38 | EST NON-AF EXCESS MAT. 39-45 | BLANK 46-80
WORK ORDER SHOP FILE (Remove/Pseudo Remote Input Format)
TRANSACTION IDENTIFIER 1-7 | 8 | CONTROL INSTL 9-12 | CC 13 | WORK ORDER NO. 14-18 | COST CENTER 19-21 | 22 | NO. REQUIRED 23-25 | ESTIMATED LABOR HRS 26-30 | ESTIMATED SHOP RATE COST 31-37 | ESTIMATED DIRECT MATERIAL COST 38-46 | ESTIMATED PROJECT CONTRACT COST 47-55 | ESTIMATED SERVICES CONTRACT COST 56-64 | ESTIMATED OTHER COST 65-73 | BLANK 74+
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W C N – A D D ,
W C N – A D D ,
W C N – A D D ,
W C N – A D D ,
W C N – A D D ,
W C N – A D D ,
– 17 TOTAL
AF FORM FEB 75 327 REVISED
BASE CIVIL ENGINEER WORK ORDER

Figure 2: A Work Order, AF Form 327.

☆ U.S. Government Printing Office: 1974—552-867

FACILITY NO	ACTIVITY OR STREET ADDRESS	DATE	TIME	CONTROL NO
NAME AND GRADE OF REQUESTOR		PHONE NO./ALTERNATE		WORK ORDER NO

SERVICE REQUIRED	ZONE NO.	TYPE OF SERVICE			
			SV CALL		IWP
			FAST		SELF HELP
			HOPPER		SMART
	ESTIMATED COMPLETION DATE				
INDICATE WHEN WORK IS TO BE ACCOMPLISHED	CREW SIZE	EST TOTAL TIME			
AREA/FACILITY WHERE JOB IS LOCATED	REMARKS *(Tools, equip, materials, special craftsman multi shop notes, etc)*				
DANGEROUS CONDITIONS EXISTING *(if any)*					
RESTRICTIONS *(time, entry, security)*					

MAKE OF EQUIPMENT	TYPE/SIZE OF ITEM	COLOR OF ITEM

ASSIGNED TO	DATE	TIME	COMPLETED BY	DATE	TIME	INITIALS	LUC 12	LUC
REFERRED TO	DATE	TIME	COMPLETED BY	DATE	TIME	INITIALS	LUC 12	LUC
DEFERRED TO	DATE	TIME	DISPOSITION		AUTHORIZED			

AF FORM JAN 74 1879 PREVIOUS EDITION WILL BE USED.

SERVICE CALL/JOB ORDER RECORD

Figure 3: The Job Order, AF Form 1879.

Authorization Specialist, who prepares an initial work order draft. Those requests designated as Job Orders are forwarded to planning. The planner finalizes all estimates for the work order and job order. He also completes the bottom half of the work order and prepares the Job Phase sheet, which is shown in Appendix VI. Real Estate reviews the work order to determine if their files are affected and returns it to the Work Authorization Specialist. The Work Authorization Specialist then prepares a final work order for approval or rejection by the Chief of Programs. Upon approval the information on the work request is input into the Base Engineer's Automated Management System's Data Base. Job orders are forwarded to Work Control for further direction.

Deficiencies in the Current System

Analysis of the current Work Request Processing System indicates a number of deficiencies. The process is excessively redundant, slow, overcome by paper work, vulnerable to the loss of documents, cumbersome to track, and it has the potential of producing inaccurate data depended upon for accurate management reports. These deficiencies are explained and documented in the following paragraphs.

Redundancy of operations is evident in three areas. First, the Work Authorization Specialist verifies that the Work Request was properly completed and if the work is the responsibility of base civil engineering. This same function is accomplished by Program Development. Secondly, there is a backtracking of the Work Request folder between the Work Authorization Specialist and all the reviewing bodies so he may keep track of the current stage of processing of the request by logging the

dates of completion of each stage in AF Form 1118, which is shown in Appendix II. Thirdly, the Work Order is prepared twice, once when work is approved for accomplishment by work order and again following secondary planning.

The timeliness of the data from the work request, which is used to produce schedules, forecasts and work plans, is diminished by the means of communication used in the current system, namely, distribution. In conjunction with this problem, the number and location of reviewing sections contributes to the need for some method of communication which would have all reviewing agencies perform their functions simultaneously. Another contribution to the timeliness of data in this current system is planning. The planner searches through the Engineering Performance Standards for task-hours, job preparation, craft allowance, and travel time. He searches the shop rate list for cost and the materials list for available materials and their cost. Once the planner has accumulated these figures, some calculation must be accomplished by hand and through the use of a nomograph to prepare the estimates of man-hours and cost.

NO LONGER THE CASE

When the Work Request has been approved the planner must again check the materials list and shop rate list for changing costs. If costs have changed beyond 10 percent of the original figure used, another estimate must be accomplished to reflect this change. Further, commitment of materials and the completion of a portion of the Work Order form is accomplished here.

Another problem can potentially develop from multiple handling of a single folder. This is the loss or misplacement of important documents.

The final area of concern is the accuracy of the data being transmitted to the files. The present processing of the Work Request through its entrance into the Base Engineer's Automated Management System produces data the integrity of which is questionable.

The first of two areas where this lack of integrity may develop is in planning. There are a number of repetitive calculations which must be performed to arrive at a good estimate. These estimates determine who is to approve or disapprove the work to be accomplished and an under estimated job can be costly, because the work request would have to be reprocessed using man-hours, or there may be a need to call upon other committed resources to complete the job. Furthermore, the extensiveness of many of the estimates require a building upon previous values. This type of continuous activity is tedius and leaves the human element performing these tasks subject to error.

It is well recognized that the highest quality of data is maintained if entry of that data into the data base takes place at the time and place of its origination. This is not the case with the Work Order entry into the Shop Files. The necessary data for the present work order form is produced in planning, yet it is entered either via remote by the Work Authorization Specialist or transfered to cards and entered. This transfer of the data is a major cause for the reduction in accuracy and integrity of data. These shop files are depended upon for the scheduling, forecasting and planning functions and should be of the highest quality if management is to have products upon which to make meaningful decisions.

Why? Do we have that many key punch errors?

These observed problem areas and the variation from prescribed procedures by the operating elements contribute to the ineffectiveness of this current process. The alternatives which will be suggested seek to minimize these problems.

II. THE PROBLEM

The subject of this feasibility study is the "Automated Work Request Tracking System." An investigation into the potential of utilizing data processing techniques and procedures to improve the current manual processing procedures of the Work Request has been conducted.

Through such an investigation, the areas of possible automation have been identified, and an overall concept of design is recommended for its improvement.

Objectives

The following objectives have been established for the systems design:

1. Improve the tracking of the Work Request throughout the several processing stages,
2. Streamline movement and processing of the request,
3. Improve the method of data capture at a single source.

The results of achieving these objectives will be the availability of more timely and accurate data.

Assumptions and Constraints

The first assumption is made to facilitate the calculations of the Work Request processing times and costs. The Work Request Processing

System at Maxwell Air Force Base represents the average operation of all bases Air Force wide.

The second assumption is that the Contractor Operated Civil Engineering Supply Store (COCESS) System and the Maintenance, Repair and Minor Construction (MAREMIC) Reporting System can be made available and can be placed on-line. Presently COCESS is not available at all bases and MAREMIC is available but not always used.

One constraint which is reasonable to meet is that any new system or alternative developed should not require any type of equipment other than what is already available through inventory or projected to be added to inventory. Such a piece of equipment is the Burroughs TD 822 Cathode-Ray-Tube unit and associated hardware and any software developed for its use. This equipment can be made available if needed.

III. DISCUSSION OF ALTERNATIVES

The problems associated with the Work Request method of receiving incoming work are many and interrelated. Therefore, any solution should not merely seek to improve one specific area in the hope that the others will fall into place. Rather, a total systems approach should be taken which would enhance the efficiency of the entire system.

Data processing techniques have proven themselves effective in many areas of production, administration, services, and engineering. Through the use of automation we wish to improve work request processing such that it will interface efficiently with the present Base Engineer's Automated Management System.

Keeping this in mind, a concept of operation has been developed which can be one of total automation as described in alternative one; partial automation, alternative two; or non-automation, alternative three.

The suggested general concept consists of five distinct stages of processing for the Work Request. This general concept is shown in figure 4. The stages are the initial Work Authorization Specialist Stage, the Initial Planning Stage or P1, the Coordination and Approval Stage or C, the final Work Authorization Specialist Stage for secondary inputs and finally the Secondary Planning Stage where entrance into the shop files would take place.

Figure 4: The Basic Concept of the Proposed Automated Work Request Tracking System.

The Work Request enters the system from the requestor at the point of the Work Authorization Specialist where it is reviewed for completeness, correctness, proper coordination and as not being in an existing contract. The status of the request is updated to P1, planning's initial stage. Planning reviews the work request in status P1 and prepares the necessary estimates through the use of the Engineering Performance Standards, Materials Listings and Shop Rate Listings. The Planner then will update the status to C for coordination and approval. If engineering is required it would be routed to that office and returned to Planning upon completion of that phase.

The Coordination and Approval Committee, which meets weekly, will review all Work Requests accumulated since the last meeting and determine whether approval is warranted and if the work should be accomplished by a Work Order or a Job Order. This committee would consist of a representative from Engineering, Fire Department, In-work-processing Programming, Safety, Real Property and any other individuals necessary to the proper coordination of the document. Also included in the committee will be the approving officials or some representative with the delegated authority to approve a Work Request. The Work Authorization Specialist would also be present to note all recommendations. The status of those work requests designated as Work Order or Job Order would be updated to status P2 for final planning.

The secondary planning stage will be concerned with the review of material's listings and shop rate listings to insure that no significant cost changes have taken place which would require recalculation of the cost estimates. Furthermore, materials would be committed to work

orders. Job orders would be reviewed for notation of special materials which may need ordering prior to the job's accomplishment.

The planner would also be responsible for the completion of the Work Order forms and transmitting that information directly to the files via some input device.

An Automated Work Request Tracking System

This alternative is one which has automated all those phases of the current system and proposed system which have the potential for improvement through automation. The general concept outlined previously indicates that the jobs performed by the Work Authorization Specialist and by the Planners would be enhanced by automation at those points. Automation of these areas is strongly supported by the amount of work required to produce the necessary estimates in the current system. This alternative will be based on the general concept described in the previous section. A detailed functional flow diagram of this automated process is provided in figures 5, 7 and 11 through 13.

This first stage is the Initial Work Authorization Specialist phase of the process and is shown in figure 5. It is characterized by the capture of the Work Request on-line through the use of a TD 822 CRT unit, equipped with the Frames Processing Package, developed by the Air Force Data Systems Design Center and described in Appendix VII.

After the review of the Work Request for completeness and for its proper use, a determination of whether the work is presently scheduled to be accomplished by contract or some other means is made. This will be accomplished by the Work Authorization Specialist reviewing a list of

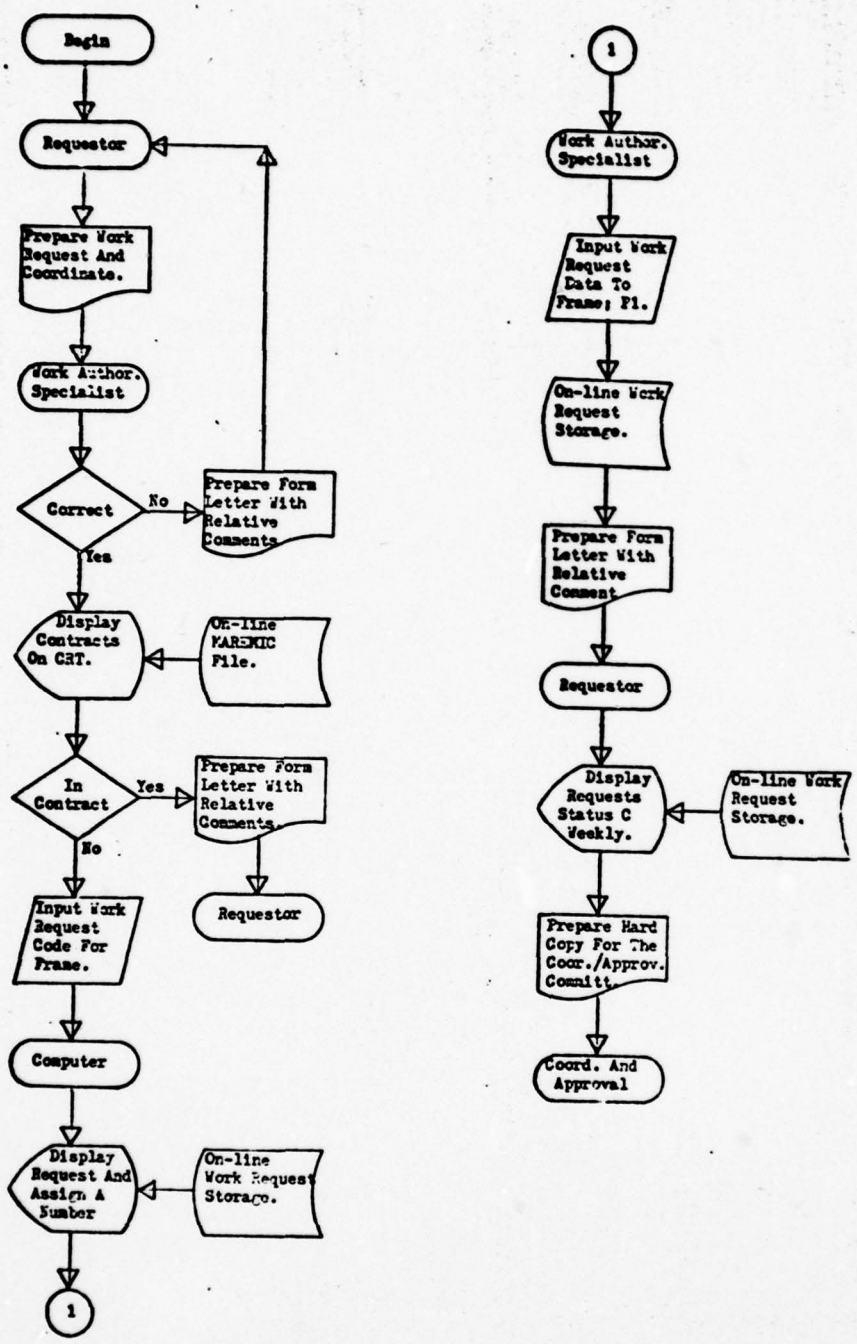

Figure 5: The Initial Work Authorization Specialist Stage of the Proposed Automated Work Request Tracking System.

contracts and/or Job Orders presently scheduled. These would be displayed on the CRT. This would necessitate the interface of this system with the Maintenance, Repair and Minor Construction System on-line, and also the projected Job Order System. It is, however, conceivable that a hard copy could be provided for such a purpose until these systems could be placed on-line.

Once these necessary reviews have taken place and the request is deemed to be new work, information from the Work Request form would be captured at this point only once. It will be input by the Work Authorization Specialist directly to a Work Request Status frame, shown in figure 6. Also on this frame will be a status section. The Work Authorization Specialist will update that section to status P1 for the Initial Planning Stage. A work request number will be assigned to the Work Request programmatically. At this time the request information from the frame will be transmitted to the Work Request File. The requestor will be notified by form letter of the work request's acceptance for processing and its work request number for future reference if inquiries are made.

The second stage is called Initial Planning and is shown in flow diagram form in figure 7. It is characterized in the present system as time consuming and having the potential of producing data which may not be of the highest quality. This is no reflection on the planners. It is the task itself which when manually performed can possibly produce errors.

The distinguishing feature of this stage in the automated system is that all calculations would be performed by the computer through an interface with the CRT and files containing the needed information.

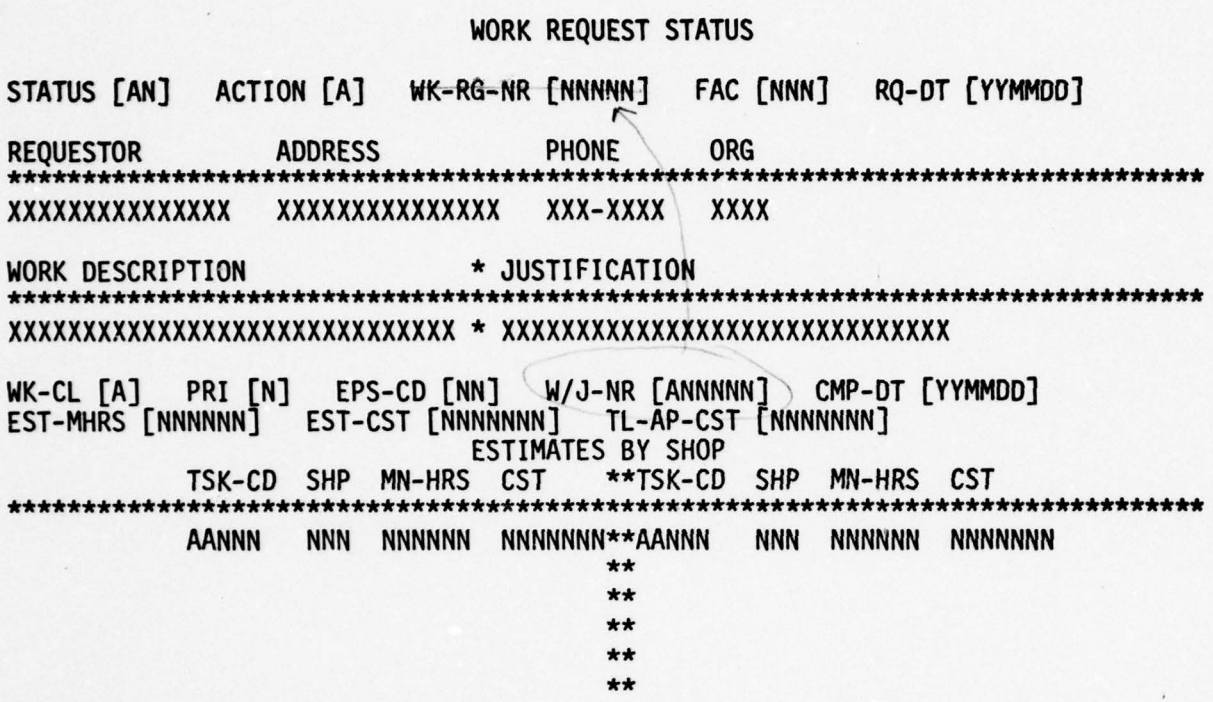

Figure 6: The Work Request Status Frame for the Proposed Automated Work Request Tracking System.

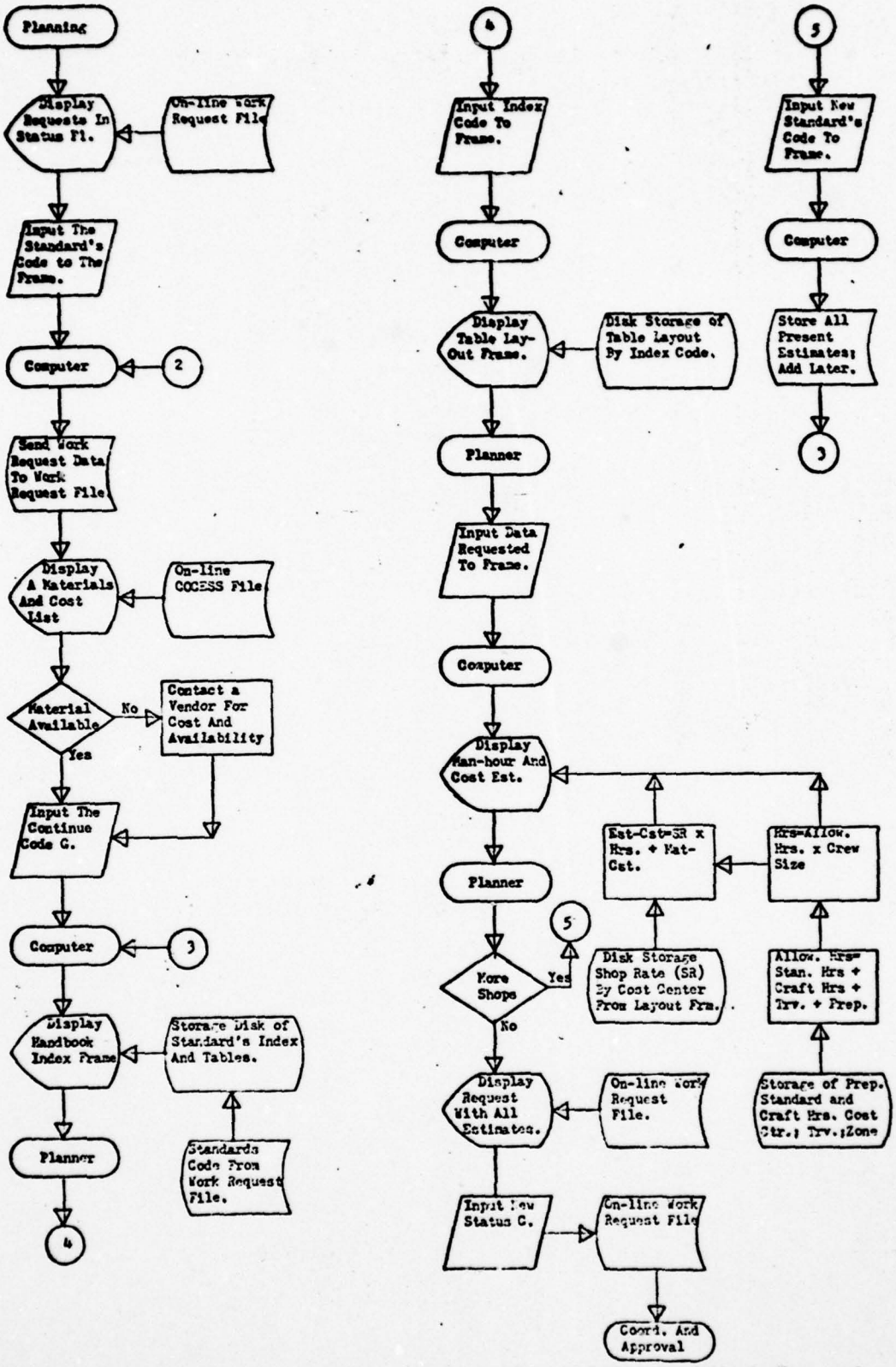

Figure 7: The Initial Planning Stage of the Automated Work Request Tracking System.

Instead of producing gross estimates, the planner can now produce an accurate estimate with little time consumption. The automation of this portion of the processing system will eliminate or reduce the potential for error and increase the timeliness of the data produced.

To achieve these calculations a TD 822 CRT unit and associated software, such as frames processing, would be needed. Files containing the Engineering Performance Standards tables must be prepared and referenced by shop from disk storage, and the Travel Time allowance must be filed by zone. Craft Allowance Time, Shop Rates and Preparation time will need to constitute a file and be referenced by shop.

The planner would call for all work requests in status P1 on a daily basis. These would be displayed on the CRT in the Work Request Frame. Once the planner has read the work description and is in possession of a copy of the sketches for the job, he would input the correct code for the Engineering Performance Standard he wished and transmit this to the computer. This would trigger the computer to initiate a sequence of operations necessary for the calculations of man-hours and cost estimates.

First, a materials list would be displayed on the CRT in a Materials Frame. See figure 8. The list would include the quantities on hand and the cost per unit. This particular on-line portion will have to be provided through an interface with the Contractor Operated Civil Engineering Supply Store System. Those bases which do not have this system must be periodically provided with an updated hard copy of materials on hand and their unit costs or have the system made available to them. When the Materials Requirements List is placed on-line it may

MATERIALS REQUIREMENTS LIST

ITEM DESCRIPTION	NAT-STK-NR	SP CD	UNIT ISSU	EST QTY	UNIT COST
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	NNNNANNNNNNNNN	AA	AA	NNN	NNNNNNN

Figure 8: Suggested Format for the Materials Requirements List Frame.

be necessary to categorize it to aid the planner in his search for materials.

The planner would now make his selection from the list, if the materials are available, or contact the vendor for price information and availability of materials. Then through his indication for continuation by input of the code G the computer will display an index of the tables available in a particular Engineering Performance Standard File based on the code input to the Work Request Status frame. Figure 9 shows the suggested format for an index listing frame. Each table description would be coded. The selected code will then be keyed into the Index Code portion and transmitted.

The computer will now display a Table Layout frame as suggested in figure 10. This frame would programmatically have input the index code by which this information was referenced, the Engineering Performance Standard code designated EPS code, the unit of measure of the requested table and under Action/Type/Size a breakdown of the columns in the table would be given. An example of the Action/Type/Size would be Install or Remove. The planner can make his selection by simply moving the cursor to the box to the right of the desired portions of the table and input an X. Furthermore, he would indicate the quantity requested in the proper units, the cost center, the zone, crew size, material units needed and the cost per unit of material. The work request number will have been programmatically input. This information transmitted to the computer would draw upon the necessary files, perform any interpolation between quantities and perform the necessary calculations shown on the flow diagram to produce the accurate estimates. These estimates then

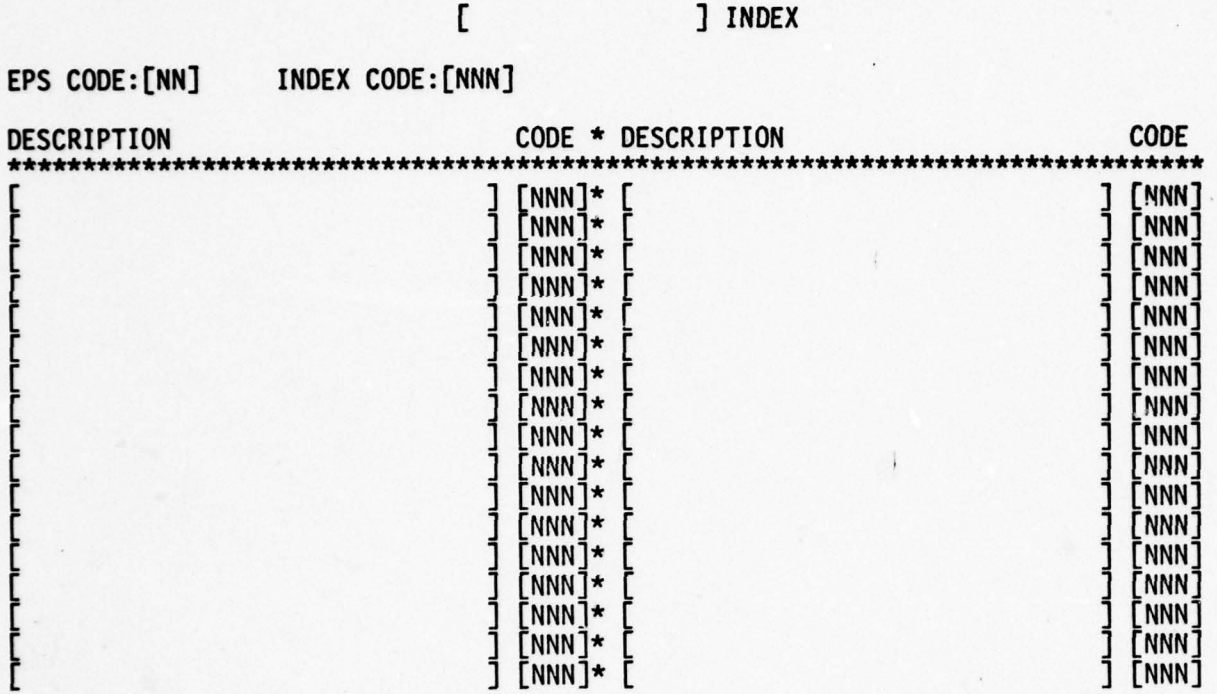

Figure 9: The Suggested Format for the Index Listing Frame of the Proposed Automated Work Request Tracking System.

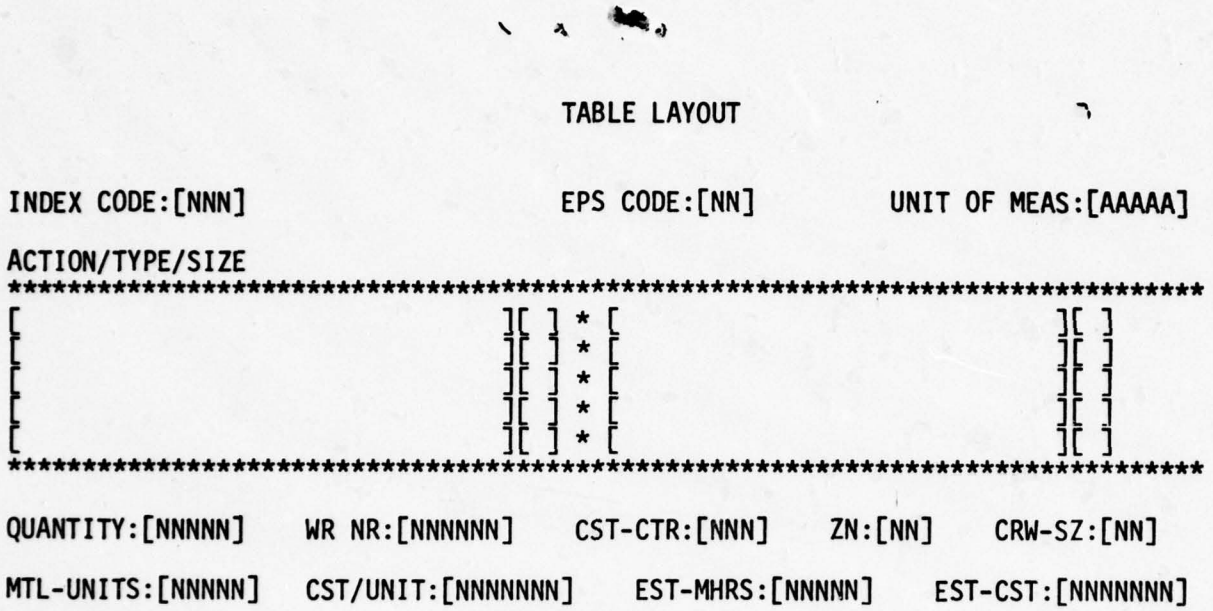

Figure 10: The Suggested Format for the Table Layout Frame of the Proposed Automated Work Request Tracking System.

would be displayed on the Table Layout frame. The shop indicated on the Table Layout frame in conjunction with the cost to accomplish the work by that shop would be sent to the Work Request File programmatically and placed in the respective areas. Other shops and the associated costs will be listed on the Work Request programmatically as they are used for the estimation. Should there be other shops involved, a change of the Engineering Performance Standard code and transmission would begin the sequence again and then add these estimates to the already calculated estimates. Finally, the indicator for continuation, G, would tell the computer to once again display the Work Request frame and display the estimates on it. The planner would then update the status to C, for Coordination and Approval and input the Work Class and Priority. A list of the task-by-task table codes will be provided programmatically to this frame also. These codes, taken from the table files, would be used by the planner to reference any specific task time in the manuals which accounted for the standard time in the on-line tables used to calculate the present estimate. These task backup tables are not on-line.

Coordination and Approval is the third stage of this process and is shown in figure 11. This stage is the most authoritative by nature of the job it is to perform. It is not automated at all, but combines all the reviewing agencies and approving officials into one decision unit. It is here that the Work Requests are given the approval to be carried through to work accomplishment or are stopped and returned to the requestor.

The Work Authorization Specialist will have hard copies produced of all those Work Requests in status C on a weekly basis and hand carry

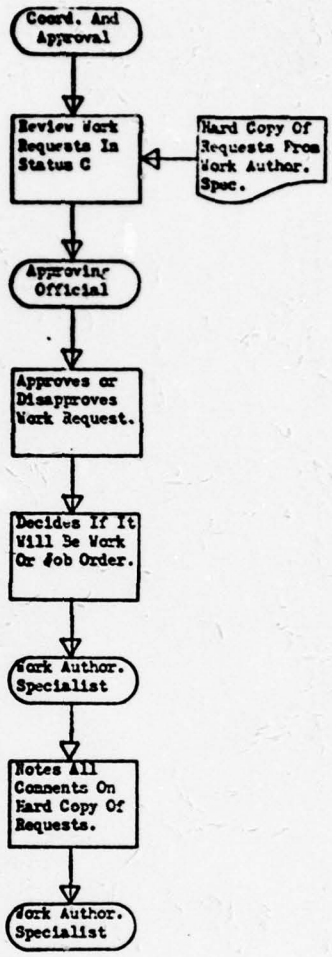

Figure 11: The Coordination and Approval Stage of the Proposed Automated Work Request Tracking System.

them to the committee meeting. The committee will first review the Work Requests and comment on each according to their respective specialties. Once all comments have been noted, the approving officials will approve or disapprove the request and determine by which method, Work Order or Job Order, the work will be completed. The In-Work-Process programmer will indicate the month of possible accomplishment. All this information will be noted by the Work Authorization Specialist and at the close of the meeting, stage four will be implemented. See figure 12.

During this stage the Work Authorization Specialist displays each Work Request by work request number and inputs a W or a J to those Work Requests which have been approved and the estimated completion date. The computer will assign a Work Order number to the Work Orders, W, and a Job Order number to the Job Orders, J. These will be placed by the computer on the Work Request. The Work Authorization Specialist will then prepare another form letter indicating whether the request is a Work Order or a Job Order and when the job will be completed and also indicate the Work Order or Job Order number. This letter is sent to the requestor. The computer can produce these form letters but the decision to do so is left to the Air Force.

Should the Work Request not be approved a form letter with reasons will be prepared and forwarded to the requestor. Then the work request would be deleted from the file.

The approved requests would then have their status updated to P2 which is secondary planning and the information accumulated thus far will be transmitted to the Work Request File.

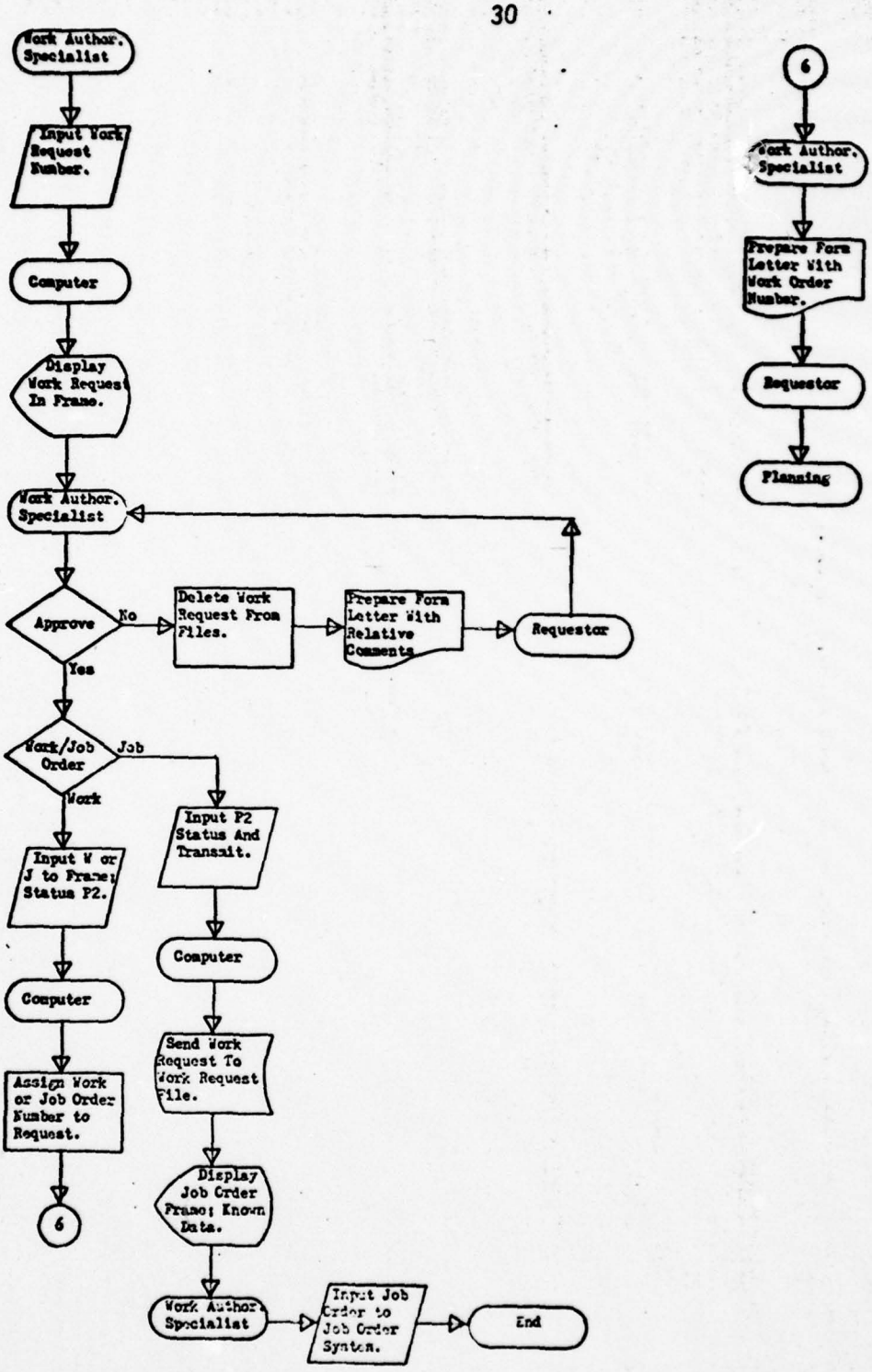

Figure 12: The Secondary Work Authorization Specialist Stage of the Proposed Automated Work Request Tracking System.

The final stage, Secondary Planning, is not always as involved as the Initial Planning stage. During this stage, shown in figure 13, the planner displays those Work Requests in status P2. After reviewing it to see what was decided by the committee, the cursor is moved to the status element and the data contained on the frame is transmitted.

The computer would read the status and the Work Order or Job Order number. This would then begin another sequence of events. Once again a display of the material listing will appear on the screen. The planner would once again check the cost of the materials and their availability. If the costs have risen above 10% of the original costs a simple entry of the EPS code would initiate the estimating sequence again. If costs have not changed the planner will commit those materials to the Work Order by completion of AF Form 1445. The input of the continuation code, G, will now display a listing of the Shop Rates by shop and if they have changed significantly the same entry of the EPS code would begin the estimating sequence again. If the cost values have not changed significantly, the entrance of a G will display a Work Order frame, figure 14, complete with those known items from the Work Request File programmatically transferred to the Work Order frame. The remaining information would be entered by the planner. This information would then be transmitted directly to the Shop Files on the Base Engineer's Automated Management System.

Should the Work Request indicate that the method of accomplishment is by Job Order, J, the planner would also check the Shop Rates and Material Listings for accuracy of the estimates, however, the computer upon completion of those actions and the entrance of a G, would display

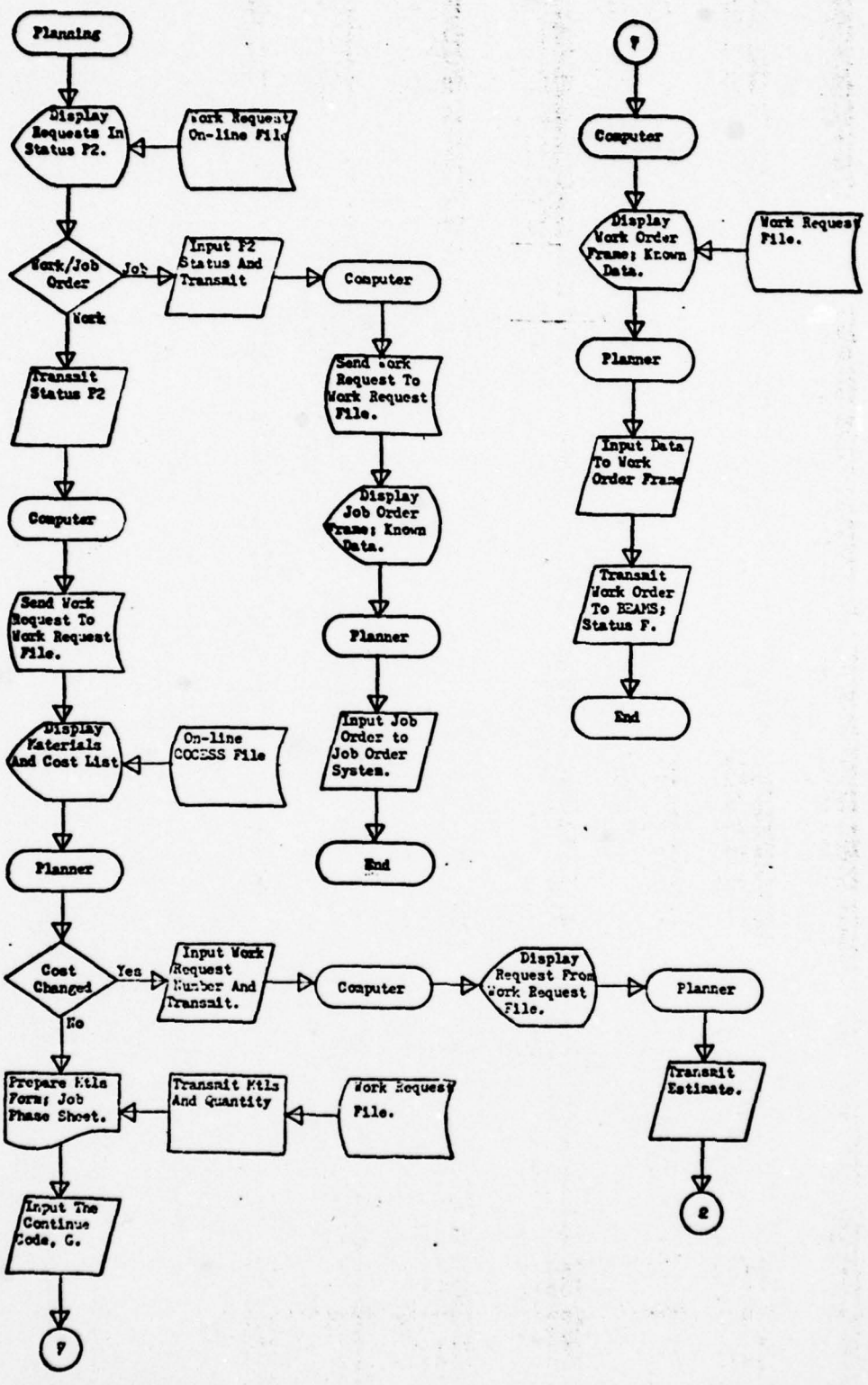

Figure 13: The Secondary Planning Stage of the Proposed Automated Work Request Tracking System.

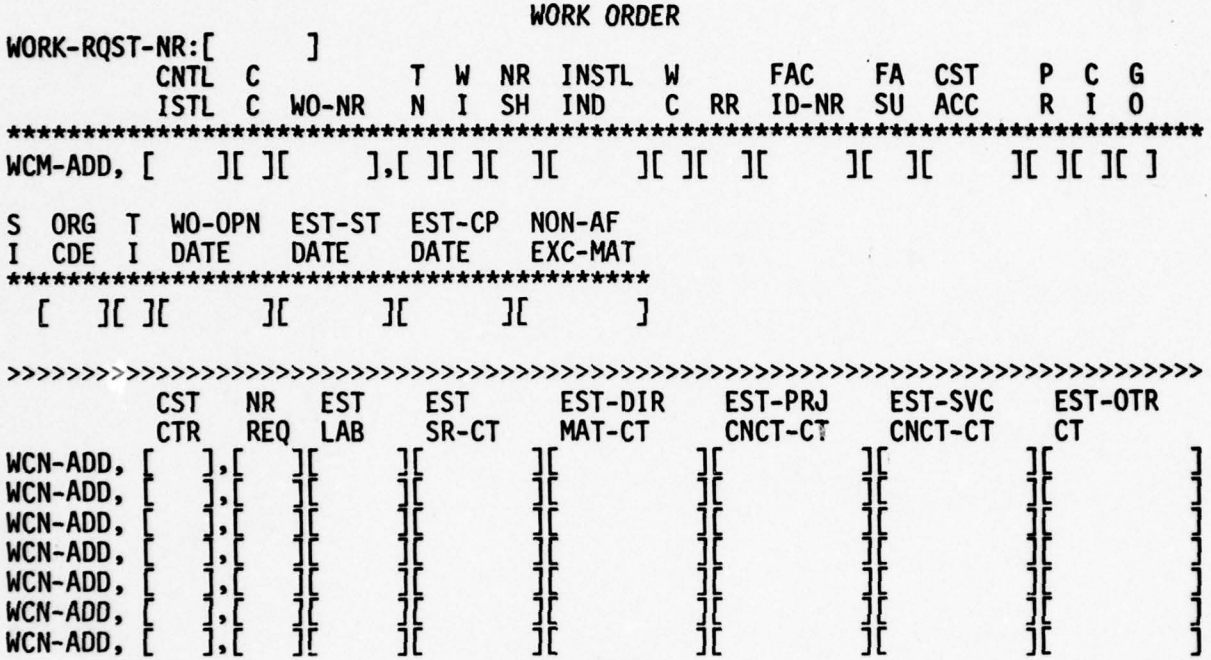

Figure 14: The Suggested Format for the Work Order Frame of the Proposed Automated Work Request Tracking System.

a Job Order frame, figure 15, and transfer the known information from the Work Request File to it. The planner would then input the remaining information and forward it to the Job Order System when it becomes available.

The computer upon recognition of that action will display the Work Request frame and the planner will indicate completion of the processing by input of an F into the status area and transmit it to the Work Request File.

A Partially Automated Work Request System

This proposal is similar to alternative one discussed in the previous section. There are two main differences. First, the planning function will be performed manually and secondly, there will be some procedural changes caused by the reduction in automation at that point.

The Work Authorization Specialist will still perform the activities outlined and flow diagramed under alternative one with a few changes or additions which will be discussed throughout this section.

Once the information has been transferred to the Work Request frame and the status updated to P1, initial planning, the Work Authorization Specialist would need to produce a hard copy of the day's accumulation of Work Requests and forward this list to Planning. The Work Authorization Specialist would still maintain a Work Request File online.

Planning must now perform the estimating procedure manually using the standards, cost and shop rate listings, and the current nomograph. These estimates would be placed on the Work Request listing. Notification of the completion of the initial estimates would need to be sent to

```
JOB-ORD,              *****JOB ORDER PROCESSING FRAME*****

CTL-INSTL [    ]                CTL-CTR [ ]          JOB ORDER NR [     ]

REQUESTOR INFO:  NAME [          ] PHONE [       ]  ORG CODE [   ]

FACILITY ID [       ] LOCATION IN BLDG [             ]  TRAVEL ZONE [  ]

WORK DESCRIPTION [                              ]

TIME AVAIL FOR ENTRY: 0700-0900 [ ]  0900-1200 [ ]  1200-1500 [ ]  1500-1700 [ ]

JOB ORDER PRIORITY [ ]     (E-EMERGENCY, U-URGENT, R-ROUTINE)

EST-HRS [      ]  EST START MONTH [    ]  RELATED JOB ORDERS:[     ] [     ]

CURRENT STATUS [ ]  (R-REVIEW, P-PLANNING,F-FUNDS, M-MATERIAL, S-SCHEDULING,
                     C-COMPLETE)

COLLECTION WORK ORDER NR [     ]            ADDITIONAL INFO AVAILABLE [ ]
```

Figure 15: The Suggested Format for the Job Order Processing Frame of the Proposed Automated Work Request Tracking System.

the Work Authorization Specialist for status update at this point. The progression through the process is by exception until the conclusion of the committee meeting. The Work Authorization Specialist, however, would need to update the status of the Work Request to the next stage, C.

The Work Authorization Specialist upon receipt of such notice either by phone or transmittal slip, would display each Work Request by work request number and update the status on the CRT screen. Then he will transmit the information to the Work Request File.

The planner will have filed the Work Requests with the initial estimates for later review by the Coordination and Approval Committee.

The committee would once again meet weekly to approve or disapprove the Work Requests as prescribed in the previous alternative. However, the Work Authorization Specialist would pick up the list of Work Requests completed from planning and hand carry them to the meeting. The committee recommendations would be noted and at the close of the meeting the Work Authorization Specialist would return to the CRT and recall the Work Requests to update the status to P2 and enter the estimates, Work Class, Priority and the committee recommendations. Once completed the computer should be triggered to produce another hard copy listing of the Work Requests with completed information in status P2. This would again be forwarded to planning for secondary planning as described in alternative one, only it is manually performed.

Completion of the planning stage and the preparation of the needed forms would next require that the information be returned to the Work Authorization Specialist. He would now display the Work Order frame

which will have known information common to the Work Request and the Work Order programmatically transferred to that frame from the file. The remaining information would be input to the frame by the Work Authorization Specialist.

If a Job Order were required the Job Order frame would be displayed and information from the Work Request File programmatically input. This would then be transmitted via some interface to the Job Order System presently being studied or if not available the Job Order will be sent to Work Control for disposition. In either case, Work Order or Job Order, the update of the originating Work Request to completion status, F, would be necessary.

A Streamlined Manual System

This alternative is non-automated. It does, however, have some of the characteristics of the current system and of the proposed basic concept. Of the current system, it keeps all the operations manual and alters the planning function minimally. Of the proposed concept it maintains five basic stages of processing. The major facet of that concept is that it utilizes the centralization of the coordination and approval activities.

This streamlined system is shown in figure 16. As you will notice from a comparison of this to the current system, the Work Authorization Specialist has some increased duties to perform. They are exactly the same functions as those in alternative one without any automation and in addition he has the responsibility of input of the work order information into the files. However, the work order is only prepared

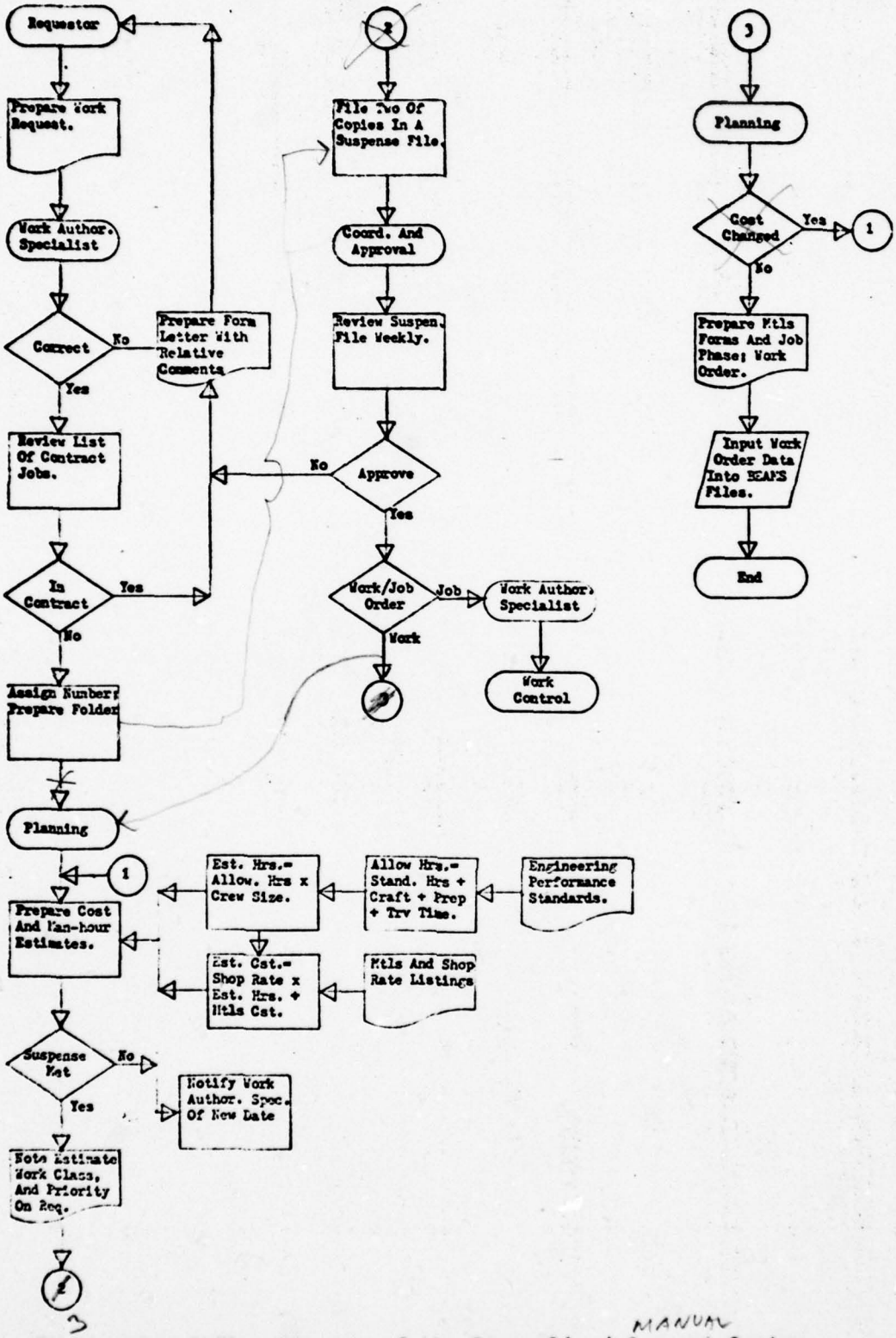

Figure 16: A Flow Diagram of the Streamlined Current MANUAL System.

once upon receipt of that recommendation of work accomplishment from the committee.

The planning function has also been altered from the current system. This alternative requires that accurate estimates be accomplished in place of the gross estimates now being performed initially. This is to eliminate the absolute need to recalculate the estimates in the secondary planning stage. Another advantage to this requirement is a possible reduction in time necessary to redirect the Work Request to another approving official after the second planning stage because an improper authorization was given. This is time consuming and costs money. It can also commit needed resources if the wrong decision is made. The best way to accomplish these accurate estimates is to require that the standards be used without fail.

This alternative requires that the Work Request Folder proceed on an exception basis to planning where it would be held for the approval committee. The approval committee meeting weekly would perform the duties as prescribed in alternative one.

Upon completion of this stage the Work Authorization Specialist would note the present disposition of the Work Request on AF Form 1118, assigning it a Work Order or Job Order number, whichever is applicable and forward it to planning, stage P2. The AF Form 1118 would need to be changed to reflect a status rather than a reviewing sequence. A suggested format for the new form is shown in figure 17.

The planner would now only need to perform the activities outlined in alternative one without the automation and then forward the completed documents with their respective work requests to the Work

BCE WORK REQUEST REGISTER

WR-NR	DESCRIPTION	DT-RCVD	P1 DATE	C DATE	P2 DATE	E DATE	W/J NR

Figure 17: The Suggested Format for the New Base Civil Engineering Work Request Register.

Authorization Specialist for either input of the Work Orders over the current remotes or forwarding of the Job Orders to the Job Order system or Work Control for direction.

IV. COST ESTIMATES

For the purpose of this study the current system of operation will be considered the baseline for cost comparisons with alternatives one, two and three. There are four basic cost types which can be identified with the alternatives. These are Development, Implementation, Equipment and Personnel costs. An explanation of what these costs involve is provided below.

Development

Development costs are a one-time cost associated with developing programs and procedures necessary to support the automated portions of the proposed systems. They involve the development of any functional specifications, designing the model, programming, coding and testing of the programs to determine their reliability. Table one shows a comparison of the required man-hours to design and test the model and also the cost associated with this development. It should be noted that all man-hour estimates and the hourly rates for the development and implementation estimates were furnished by the Air Force Data System Design Center's personnel, who are responsible for such estimates. The cost values shown in the table for the alternatives were obtained by multiplying total man-hours by the hourly rate. Notice that the table shows a difference in the amount of hours for alternatives one and two. This is due to the extent of automation which each will have if implemented.

TABLE I

The One-time Cost Estimates for Each Alternative

Alternatives	Development (Man-hours, $)				Implementation (Man-hours, $)				
	Design	Test	Total	Cost	Analysis	Document	Coordinate	Total	Cost
1. Automated	4163	462	4625	39590	125	150	50	325	2782
2. Partially Automated	3482	82	3520	30131	125	150	50	325	2782
3. Non-Automated	0000	000	0000	00000	125	150	50	325	2782

Alternative three shows no entries in the development section of the table. This is because alternative three is non-automated.

Implementation

Implementation costs consist of the costs associated with the analysis of the proposed system in operation, both functionally and from the computer workload aspect; secondly, documentation costs will be incurred to rewrite manuals and regulations to reflect the system's changes; and finally, coordination costs will be incurred when the system is made available to all Air Force Bases. Once again table one shows a comparison of the man-hours required for implementation and the total costs for each alternative. These costs were computed through the use of the formula given for computation of development costs.

Equipment

Equipment rental and maintenance costs will be those associated with the use of the TD 822 Cathode-Ray-Tube intelligent terminals and the prorated share of the excess on-line disk module space available at each of the bases. Table two shows a comparison of the annual equipment costs for each alternative. Alternative one will require four CRT units at each of the one hundred and fifteen bases throughout the Air Force. This is reflected in the first column of the table. One of the four will be located at the Work Authorization Specialist's desk with a printer. The remaining three units will be shared by the Planners. They will also have a printer. Each unit will cost $205 per month. This figure was acquired from the Air Force procurement agency responsible for the equipment's acquisition. That figure used in conjunction with the

TABLE II

The Annual Cost Estimates for Each Alternative and the Current System

Alternatives	Equipment				Personnel			
	CRTs	Cost($/yr)	Disk	Cost($/yr)	Specialist	Cost($/yr)	Planner	Cost($/yr)
1. Automated	4	1131600	300	12755	5.88	855624	4.52	9928711
2. Partially Automated	1	282900	90	3827	5.97	867744	7.17	15739523
3. Non-Automated	0	0000000	000	00000	8.17	1187694	7.17	15739523
4. Current System	0	0000000	000	00000	10.73	1560969	7.87	17276872

expression shown below, produced the cost shown in column two of table two.

Total Cost/Year = Number of Units × Cost/Unit × 12 Months/Year × 115 Bases.

The disk space necessary to accommodate the new files required for alternatives one and two amounts to approximately 300 thousand and 90 thousand bytes respectively. Each disk has a capacity of 20 million bytes. The rates per month for a disk module is $616.20. Therefore, the total cost per year for rental of the disk space is given by the following formula:

Total Cost = Number of Bytes Per Base/20 Million Bytes × Cost/Unit × 12 Months/Year × 115 Bases.

Notice that equipment cost are non-existent for alternative three and the current system. This is because no additional equipment is needed.

Personnel

The Personnel costs are incurred because it is necessary to have the human element control the automated system. Although estimates indicate a potential for a 50% reduction in manpower by a 50% increase in the productivity, the human element cannot fully be eliminated. The personnel areas considered in the cost estimates are the Work Authorization Specialist and the Planners. The reviewing agency personnel and the approving officials costs are considered equal for all alternatives and the current system. This is because reviews and approvals must still be accomplished. However, because of the consolidation of this function into a central decision unit at a central point and having all the

necessary information present on the Work Request, it is conceivable that economies may be realized.

Personnel costs are also annually incurred and are shown in table two. The figures shown under the Work Authorization Specialist column are the estimated number of man-hours per day required to process the daily average workload of Work Requests. These figures were determined through interviews with the Work Authorization Specialist about their phase of the processing and through the observation of the current system in operation. A breakdown of the activities of the Work Authorization Specialist in minutes per day is given in table three. These estimates for all the alternatives were converted to man-hours and placed in table two. The average pay grade of the Work Authorization Specialist is a GS-5 or $10117 per year, according to the latest figures on pay rates for government employees. This figure used with the following formula,

$$\text{Total Cost/Year} = \text{Salary/Hour} \times \text{Man-Hours/Day} \times 115 \text{ Bases} \times 260 \text{ Days/Year}$$

yields the total cost for the personnel at that stage of processing per year for all Air Force bases combined. This is the figure shown in column six of table two.

Table four shows a breakdown of the activities of the planner required to process the Work Request. The figures are given in minutes per day per Work Request. The planning section is presently able to handle about 10 Work Requests daily as determined by the Chief of Planning. Table two gives the number of man-hours required for processing of the Work Request. The average pay grade of the planner is a GS-9 or

TABLE III

Estimates of the Work Authorization Specialist's Daily Tasks (Min/Dy)

Description of Task	Automated	Partially Automated	Non-Automated	Current System
Review for Correctness	40	40	60	60
Prepare Form Letters	35	40	60	60
Determine Reviewers; Assign Number; Log	00	00	00	52
Create a Work Request Folder	00	00	70	40
Prepare Review Sequence Slip	00	00	12	12
Prepare Copies of the Work Request	00	00	00	56
Determine Approving Official; Log	00	00	40	20
Review Committee or Reviewer Recommendation	20	25	20	20
Prepare Draft and Final Work Order	00	00	00	120
Input Work Order to Shop Files	00	00	60	60
Prepare Summary Reports	20	15	24	24
Answer Requestor's Questions	60	60	60	60
Review Contract Listings	40	40	00	00
Call Frames and Enter Data	20	20	00	00
Copy Sketches	20	20	00	00
Prepare Listing of Requests in Status C	4	4	00	00
Meeting Time	24	24	24	00
Deletions from Files	10	10	00	00
Personal Time	60	60	60	60
Totals	353	358	490	644

TABLE IV

Estimates of the Planner's Daily Tasks (Min/Dy)

Description of Task	Automated	Partially Automated	Non-Automated	Current System
Review Work Request	00	10	10	10
Visit Job Site	90	90	90	90
Determine Materials and Shops Required	60	60	60	60
Research Materials and Costs	00	30	30	30
Search Standards for Descriptions and Time	00	20	20	20
Prepare Gross Estimates	00	00	00	10
Prepare Drawings	00	00	00	30
Prepare Job Phase Calculations Sheets	00	60	60	60
Prepare Work/Job Order	5	20	20	20
Prepare Materials Forms	20	20	20	20
Prepare Accurate Estimates	00	60	60	60
Display and Review Work Requests Status P1/P2	15	00	00	00
Input EPS Codes	10	00	00	00
Review Materials Lists	10	00	00	00
Select Desired Standards Table from Index	7	00	00	00
Input Data to Table Layout Frame	4	00	00	00
Input Data for Additional Shops	10	00	00	00
Personal Time	60	60	60	60
Totals	266	430	430	472

$15278 per year. Thus the cost figure shown in table two for the cost of the planning section Air Force wide is given by the expression:

Total Cost/Year = 10 Work Requests/Day × Man-Hours/Work Request ×
115 Bases × 260 Days/Year × Salary/Hour.

Table five shows a summary of the costs for all the alternatives. Notice that the one-time cost for alternative one is considerably higher than alternatives two and three. However the annual operating cost for the automated system is much lower and indicates that considerable savings may be realized. Also, the annual operating costs of alternatives two and three are almost alike with number two better by only $30 thousand. This is due to the improvement of alternative three through partial automation.

TABLE V

A Summary of Costs

Cost Types	Automated	Partially Automated	Non-Automated	Current System
Development (One Time Cost	39590	30131	00000	00000
Implementation (One Time Cost)	2782	2782	2782	00000
Total One Time Cost	42372	32913	2782	00000
Equipment (Annual Cost)	1144355	286727	00000	00000
Personnel (Annual Cost)	10784355	16607267	16927217	18837841
Total Annual Cost	11928690	16893994	16927217	18837841

V. BENEFITS

The benefits associated with the alternatives described in the previous chapters provide a means for measuring how well the designs meet the desired objectives. These benefits are in the form of time savings, cost savings, a reduction in unnecessary paperwork, efficient tracking of the work request, increased data integrity and a reduction in the potential for loss of important documents. A listing of the benefits for each of the alternatives is given in the following sections.

The Benefits of an Automated Work Request Tracking System

Analysis of this alternative indicates that the following benefits will be realized:

a. The CRT located at the point of entry of the Work Request, that is, at the position of the Work Authorization Specialist, accomplishes the following:

1. Eliminates the necessity to maintain a manual log AF Form 1118.

2. Eliminates the necessity for preparation of the sequence review slip.

3. Eliminates the necessity to prepare the Work Order, AF Form 327, at this point.

4. Eliminates the necessity to maintain a Work Request Folder.

5. Provides a means for knowing at which stage in the process the Work Request is at any point in time by merely requesting it by the Work Request Number or by status.

6. Provides an efficient means for preparing Management Reports, such as, the number of requests in a certain status. For example, suppose management wishes the number of work requests in the planning stage to determine the workload or efficiency of that section. A simple request of a listing of those jobs by status will accomplish it. Another report may consist of a listing of the work requests for the year to determine any trends. This also could be accomplished by requesting such data from the Work Request File.

7. Provides a means for transferring work request data without the need of manual systems such as distribution.

8. Provides a central point for the requestor to have questions answered concerning their work request.

9. Provides data which is high in quality because it is only captured once and built upon until entry into the shop files.

10. Provides approximately a 50% increase in productivity.

b. The Centralized Reviewing and Approval Committee allows for the benefits listed below.

1. It eliminates the movement of the Work Request Folder from one reviewing agency to another. This reduces the time needed to perform these reviews and reduces the time for processing.

2. It eliminates the need to research any questions about the request since all pertinent information will be present at the time of the review.

3. It eliminates the backtracking of the Work Request between the reviewing agencies and the Work Authorization Specialist.

4. It provides a central decision making unit to determine the disposition of the Work Request.

5. It reduces the time spent by the Work Request in processing to acquire the proper authorization.

c. The CRT units located in planning will provide the benefits listed.

1. A means for producing more accurate estimates.

2. Access to standards without the searching now necessary.

3. On-line access to Materials listings when available.

4. An increase in productivity by approximately 50%.

5. A means of preparing management reports for their activities.

6. A means of reducing the time necessary to complete an estimate.

7. A means by which the Work Order or Job Order can be completed on-line by the computer's input of known data from the Work Request File and the planner's input of the remaining information. This also increases data integrity.

8. A means of updating the shop files at the point of data production. This increases the accuracy of those files and reduces the need for error correction.

9. An overall reduction in time for the production of the estimates.

10. Eliminates the need for recalculation of the estimates in most cases.

The Benefits of a Partially Automated Work Request Tracking System

The folloiwng reduced set of benefits are attributable to alternative two.

a. The CRT available to the Work Authorization Specialist for this alternative will accomplish the following:

1. Eliminate the necessity to maintain a manual log.

2. Eliminate the necessity for preparation of the sequence review slip.

3. Eliminate the necessity for maintaining the Work Request Folder.

4. Provide a means of preparing the Work Order or Job Order only once and entering this information directly to the files.

5. Provide a means of tracking the work request through all phases of the processing.

6. Provide an efficient means for preparing management reports for trend evaluation.

7. Provide a central inquiry point for the requestor.

8. Provide for the capture of the Work Request on-line and building upon it.

9. Provide for approximately a 50% increase in productivity.

b. The Centralization of Reviewing and Approval allows for all the benefits associated with the first alternative with no added benefits.

c. The planning section will still be encouraged to fully use the Engineering Performance Standards to accomplish their estimates. This will yield the following benefits:

1. A reduction in the need to recalculate estimates.

2. These more accurate estimates reduce the chance of having to reprocess the request through the approving officials because of any under estimation.

3. There will be a slight increase in producitvity realized over the current system.

The Benefits of Streamlining the Current System

This alternative is strictly manual, however, its implementation will provide certain benefits over the current system.

a. The activities provided by the Work Authorization Specialist will achieve some cost benefits from a reduction in the required time to accomplish their task. This savings will be reflected in the cost savings benefits, table six.

b. The benefits associated with the centralized reviewing and approval are exactly equal to those of alternatives one and two.

c. The planners are once again encouraged to seek a higher degree of accuracy in estimating by the use of the standards initially. Thus, they will benefit as described in alternative two.

The cost benefits associated with each alternative are given in table six. The table shows that each alternative will realize a cost savings over the current system, with the largest saving being realized by the first alternative. Alternative three will utilize the centralization of the reviewing and approving officials. It will still be manual,

TABLE VI

Cost Benefits as Compared to the Current System

Description	Automated	Partially Automated	Non-Automated
One Time Cost	42372	32913	2782
Annual Cost	11928690	16893994	16927217
Total Cost	11971062	16926907	16929999
Savings Over the Current System, Year One	6866779	1910934	1907842
Annual Cost	11928690	16893994	16927217
Savings Over the Current System, Annually	6909151	1943847	1910624

but will realize a $1.9 million savings over the current system. The second alternative will add to alternative three the automation of the Work Authorization Specialist's functions for tracking. This will increase the savings over the current system by alternative three by $30 thousand. Finally, the automation of the planning functions will enhance alternative two to give alternative one. Alternative one shows a maximum estimated potential savings over the current system of better than $6.9 million.

VI. RECOMMENDATIONS

The most appropriate solution to the problem and the alternative which best meets the objectives stated is alternative one. Therefore, it is the recommendation of this investigator that the Automated Work Request Tracking System described under alternative one be accepted for development and implementation.

There is no need to wait an unreasonable amount of time to implement such an alternative. The recommended procedure for implementation is to implement alternative three first. This simply is a streamlining of the current system by combining the reviewing and approval personnel into a single decision unit. Further, the requirement that planning produce more accurate estimates initially, through the use of the standards, will be an improvement over current procedures.

While this phase of implementation is becoming accepted procedure for the operators, the second phase of implementation may be developed. This phase would include the addition of a CRT unit for the Work Authorization Specialist and an on-line Work Request File. This is alternative two. The changes to alternative three would be minimal and there would be a yearly savings realized. Furthermore, this would give flexibility to the Work Authorization Specialist for the preparation of reports in any form desired. It will also provide an on-line history file for possible trend analysis.

The third stage of this implementation is the automation of the planning functions as described in alternative one. This would provide flexibility to the planner. Not only would he have estimates with minimal deviation from actual, but it would give the planner a tool which can be used to develop reports and products to aid management in the decisions necessary for the effective coordination and control of that section.

This three phase implementation will place little burden on the operational personnel and gradually increase productivity, accuracy and the timeliness of the current system. A major outcome of this recommended system will be the annual savings realized.

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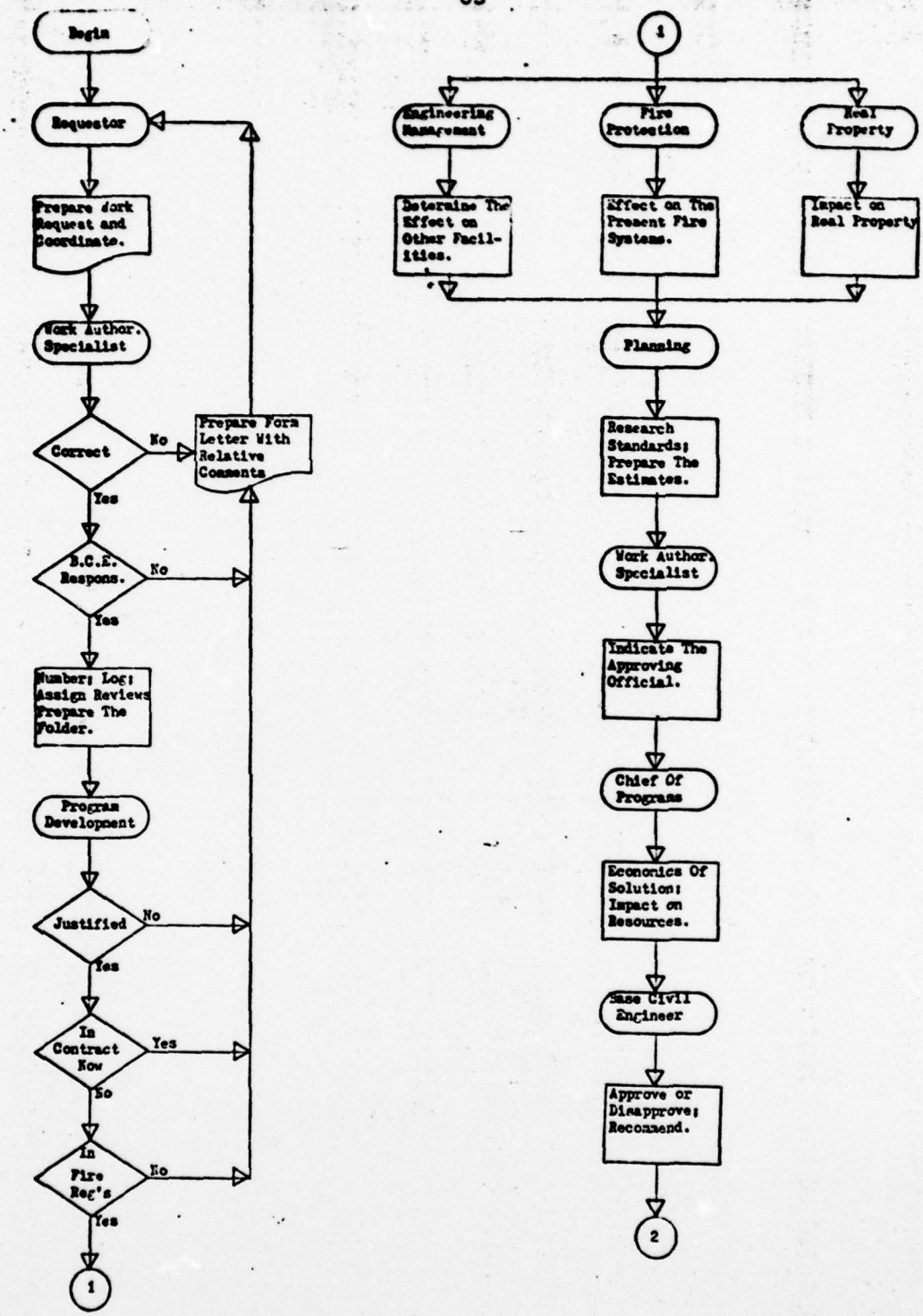
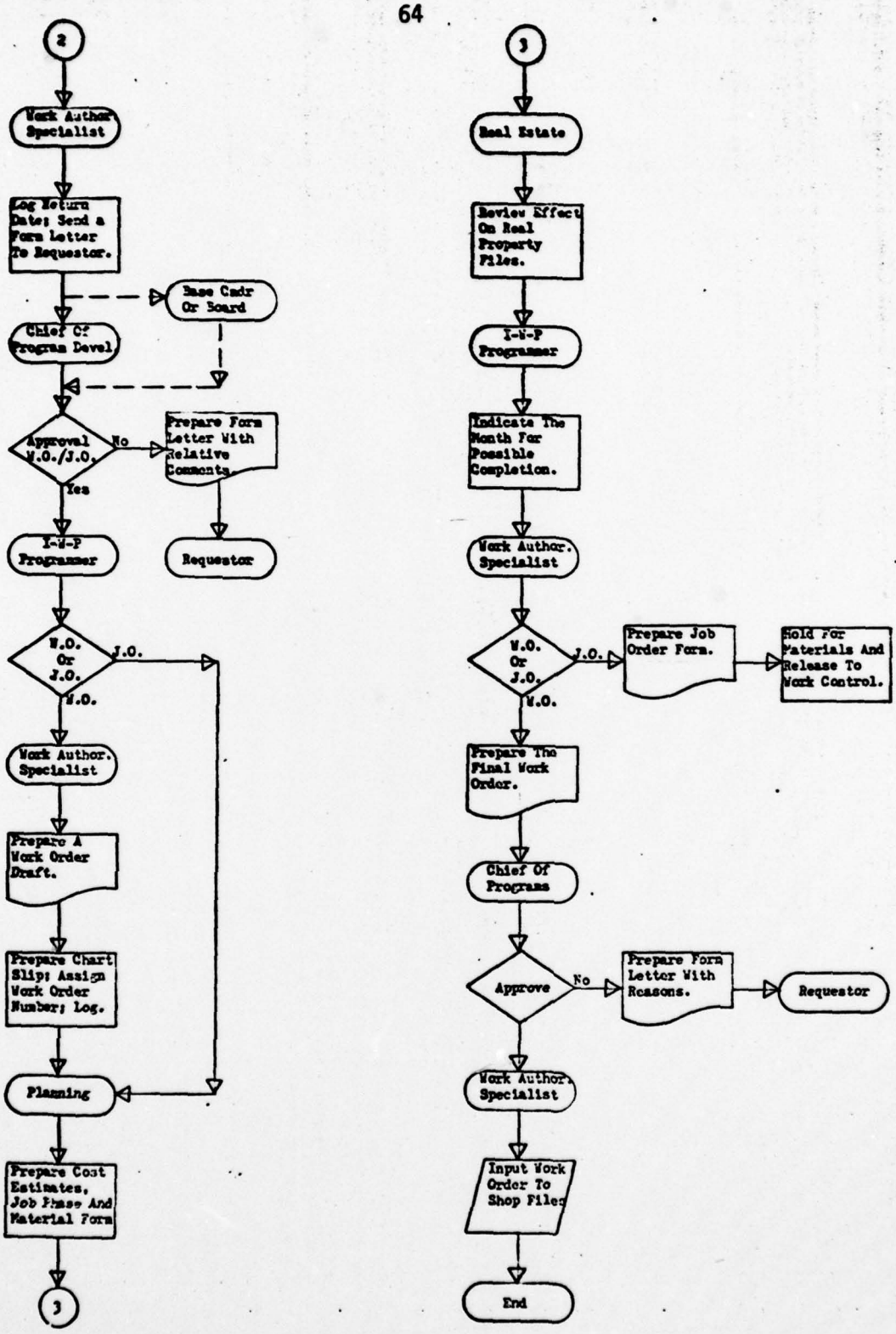
APPENDICES



Appendix I: A Flow Diagram of the Current Work Request Processing System.



Appendix I: (continued).

BCE WORK REQUEST REGISTER (AF Forms 332)

WORK REQUEST NO.	DESCRIPTION	DATE RECEIVED F.Y. 75	PROCESSING SEQUENCES AND SUSPENSES: PROG. DEV. SEQ. / SUSP. DATE	PLANNING SEQ. / SUSP. DATE	ENG. MGR. SEQ. / SUSP. DATE	FIRE PROT. SEQ. / SUSP. DATE	OTHER SEQ. / SUSP. DATE	PROGRAMS SEQ. / SUSP. DATE	BCE SEQ. / SUSP. DATE	DATE TO PROG. DEV. FOR FCLTY BOARD	ACTION TAKEN BY APPROVAL AUTHORITY	REMARKS (Work Order No. Status, etc.)
102-3	INSTALL REMOTE BOOTH BLDG 310	20 Nov	1/24 Nov	4/8 Dec	3/10 Dec	2/20 Nov		5/12 Dec	6/15 Dec	18 Dec	APPD 29 Dec	W/O 04375
103-3	CONSTRUCT SIDEWALK	20 Nov	1/24 Nov	2/29 Nov				3/1 Dec	4/8 Dec	18 Dec	DISAPPD 29 Dec	OWNERS OF NEED RIGHTS IN 4YR
103-4	FABRICATE A/C CHOCKS	21 Nov	1/24 Nov	2/29 Nov				3/30 Nov	4/50 Dec	18 Dec	APPD 29 Dec	

AF FORM 1118

Appendix II: The Base Civil Engineering Work Request Register, AF Form 1118.

BCE WORK REQUEST ROUTING SLIP		
	FUNCTION (FORWARD IN TURN)	SUSPENSE DATE
1	PROGRAM DEVELOPMENT	9 August 1972
4	PLANNING	28 August 1972
2	FIRE PROTECTION	11 August 1972
3	ENGINEER	15 August 1972
	REAL ESTATE MANAGEMENT	
5	CHIEF OF PROGRAMS	30 August 1972
6	BCE	4 September 1972
7	WORK AUTHORIZATION SPECIALIST	N/A

Appendix III: The Base Civil Engineering Work Request Routing Slip.

		APPROVAL AUTHORITY					
TYPE OF WORK	CLASS	DEPD	DEP	DED	CC	AU	USAF
Appropriated	M	1500	3000	25000	50000	250000	-
	R	1000	2500	12500	25000	200000	-
	MC	500	1000	3500	10000	75000	-
Nonappropriated	MC	500	1000	3500			
Family Housing	M	1500	3000	25000			
	R	1000	2500	12500			
	MC	100	250	500			

NOTE: The approving authorities are DEPD or Program Development, DEP or Programs, and DED or the Base Civil Engineer. CC is the Base Commander, Major Air Command and USAF is Headquarters United States Air Force.

Appendix IV: The Breakdown of Approval Authorities by Estimated Job Cost.

AF Form 1445, SEP. 69. PREVIOUS EDITION WILL BE USED.

TRANSACTION IDENTIFICATION CODE (1) | DELIVERY DESTINATION (3)

MATERIALS AND EQUIPMENT LIST

STOCK NUMBER (2)	NOMENCLATURE	UNIT OF ISSUE (4)	QUANTITY (5)	UNIT COST	TOTAL COST	TRANSACTION SERIAL NUMBER (10)	DEMAND CODE (11)	IN STOCK YES	IN STOCK NO	DATE EXPECTED	REC. BY BCE	EXCESS MATERIALS QUANTITY	EXCESS MATERIALS DISPOSITION

ACTIVITY CODE (6)	ORGANIZATION CODE (7)	SHOP CODE (8)	DATE MATERIAL REQUISITIONED (9)	WORK ORDER NO. (13)	TRANSACTION EXCEPTION CODE (13)	MATERIAL CONDITION (14)	FORCE ACTIVITY DESIGNATOR (15)	SYSTEM DESIGNATOR (16)	PROJ. CODE (17)		
DELIVERY PRIORITY (18)	REQUIRED DELIVERY DATE (19)	URGENCY JUSTIFICATION CODE (20)	FACILITY NO. (21)	INST. CODE (22)	JOB ORDER NO. (23)	PLANNER	PAGE ___ OF ___ PAGES	HOLDING AREA BIN LOCATION			
SHOP TITLE	RECEIVED BY	MONTH	FOLLOW-UP DATA FOR BACK ORDERED MATERIAL							WORK ORDER NO.	
			1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31								

Appendix V: The Materials and Equipment List, AF Form 1445.

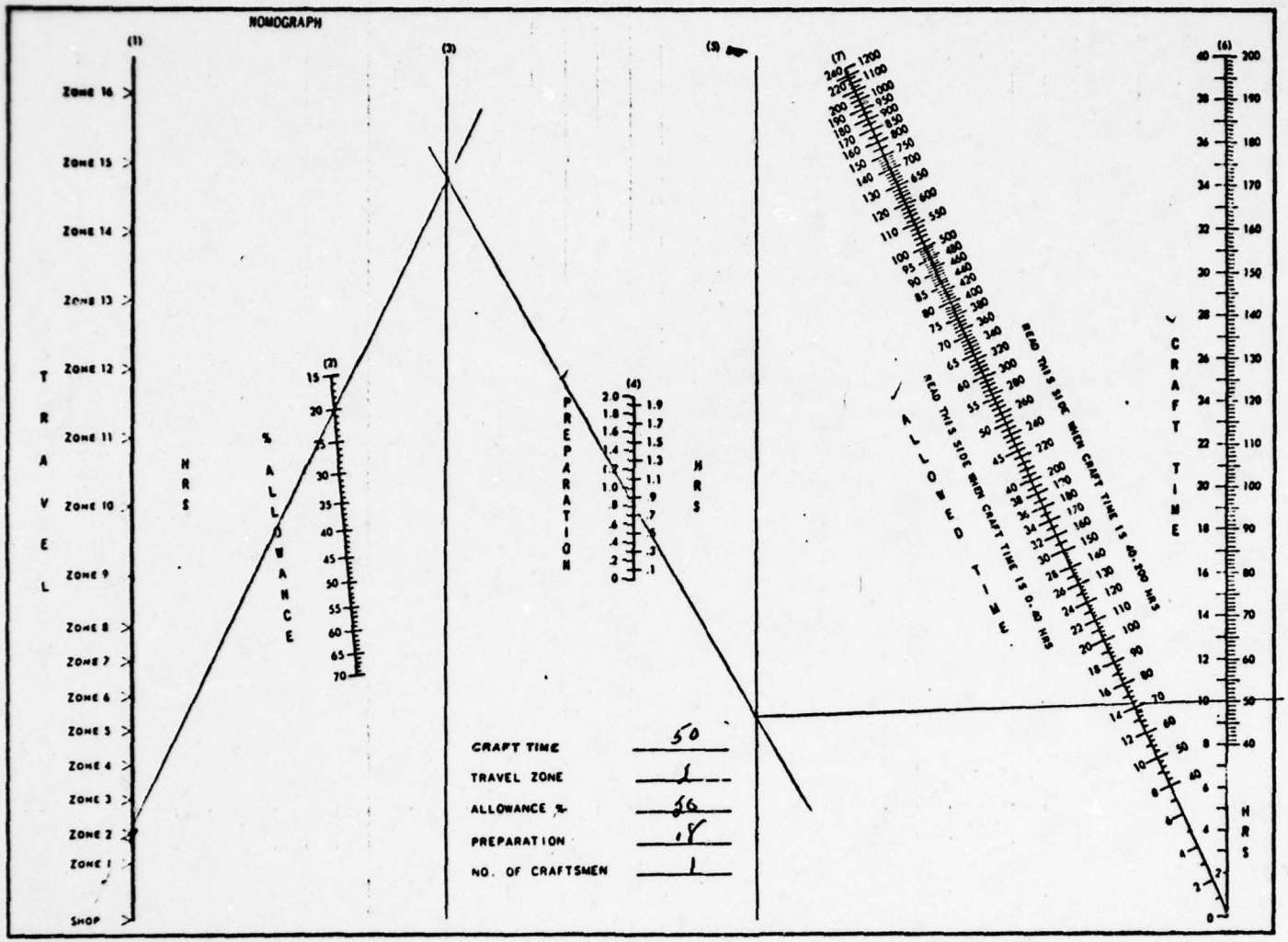
JOB PHASE CALCULATION SHEET			This form should be used for both EPS and NON-EPS estimates.
1. CRAFT PHASE NO.	2. JOB PHASE NO.	3. JOB IDENTITY NO.	4. DATE
5. WORK CENTER NO. AND TITLE			
6. JOB PHASE DESCRIPTION			

REFERENCE A	TASK DESCRIPTION B	EPS ESTIMATED TIME			NON-EPS ESTIMATED TIME F
		UNIT HOURS C	OCCURRENCE D	CRAFT TIME E	
		TOTALS (EPS and Non-EPS)			
		ALLOWED TIME			
PLANNING TECHNICIAN		TOTAL JOB PHASE TIME			

AF FORM JUL 70 1081

A-21771

Appendix VI: The Job Phase Calculation Sheet, AF Form 1081, Side One.



U.S. GOVERNMENT PRINTING OFFICE : 1971 O - 417-356

Appendix VI: (continued). The Nomograph of the Job Phase Calculation Sheet.

Appendix VII: A Description of the CRT Frame Processing Subsystem.

The CRT Frame Processing Subsystem was designed to satisfy existing requirements for transmitting data from a terminal device directly to disk storage at the computer site, for editing capabilites at the source data entry point, and for format control on the CRT terminals. The subsystem consists of three components: a Frame Processor, a Frame Compiler, and two Cobol Support Programs. The Processor is written in Burroughs Assembly language as overlays to the Data Communication Control System; the Compiler uses a data base management system, the Air Force On-Line Data System, for file and frame maintenance. Frame Processing capitalizes on the CRT forms mode of separating protected and unprotected data. Under this concept, frames can be defined by a user, stored by the Subsystem, and later recalled for use in inputting or retrieving transaction data. The Compiler, from on-line user inputs, will build and format disk records containing the frame, data descriptions, and the functions to be performed on the unprotected data when the frame is used for transaction processing. The Processor will perform the functions described in the disk records and will act as the data communications link between the CRT user, the disk records, and the Compiler. When transaction data, associated with a particular frame and data description record, is transmitted, the Subsystem can validate its accuracy while the keyboard operator is still available to make corrections. Thus, Frame Processing is a CRT software capability that makes use of the responsiveness of the Computer with the CRT operator in an on-line environment.